Instructions

MASTER MONITOR

MODEL 4TM21A1, REVISION D

EBI—3640B

GENERAL ELECTRIC

INSTRUCTIONS

MASTER MONITOR

MODEL 4TM21A1, REVISION D

EBI—3640B

MILITARY COMMUNICATIONS DEPARTMENT

GENERAL ELECTRIC

ELECTRONICS PARK, SYRACUSE, N. Y.

PRINTED IN U.S.A.

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GENERAL SERVICE INFORMATION

SAFETY NOTICE

WARNING

VOLTAGES USED FOR THE OPERATION OF THIS EQUIPMENT ARE DANGEROUS TO HUMAN LIFE.

This instruction manual is written for the general guidance of maintenance and service personnel who are familiar with and aware of the dangers of handling electric and electronic circuits. It does not purport to include a complete statement of the safety precautions which should be observed in servicing this or other electronic equipment. The servicing of this equipment by inadequately trained or inexperienced personnel involves risks to such personnel and to the equipment for which the manufacturer can not accept responsibility. Personnel servicing this equipment should familiarize themselves with first-aid treatment for electrical burns and electrical shock.

PRODUCTION CHANGES

From time to time it becomes necessary to make changes in the equipment described in this book. Such changes are made to improve performance or meet component shortages and are identified by a revision letter following the model number stamped on the nameplate. The changes in the equipment as they affect the instruction book are listed on a Production Change Sheet included in the book. If no Production Change Sheet is included, no changes have been made. The revision letter appearing on the title page indicates the equipment revision to which the book corresponds.

This information is provided as a servicing aid; it should not be used to modify earlier equipments to incorporate later revisions except under specific instructions. Please mention the revision letter in any correspondence.

REPLACEMENT PARTS

The parts list contained in this book includes all principal replacement parts. The symbol numbers are the same as those appearing on elementary and other drawings. Whenever possible, replacement parts should be obtained from a local electronics supply dealer. If it is necessary to order a part (other than a tube or transistor) from the General Electric Company, please include the symbol number, description, and drawing number of the part and model number of the unit. Orders may be sent to the nearest office appearing on the list at the end of the book or the General Electric Company, Visual Communication Products, Electronics Park, Syracuse, N.Y.

REPLACEMENT TUBES AND TRANSISTORS

In all cases replacements must be ordered from a local distributor.

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation, or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

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WARRANTY

The General Electric Company (hereinafter called the Company) warrants to the Purchaser that the equipment will be free from defects in material, workmanship, and title, and will be of the kind and quality designated or described in the contract. The foregoing warranty is exclusive of all other warranties whether written, oral, or implied (including any warranty of merchantability or fitness for purpose). If it appears within one year from the date of shipment by the Company that the equipment described in this instruction book does not meet the warranties specified above and the Purchaser notifies the Company promptly, the Company shall thereupon correct any defect, including non-conformance with the specifications, at its option, either by repairing any defective part or parts or by making available at the Company's plant, a repaired or replacement part. In lieu of the foregoing, the standard published tube warrranties in effect on the date hereof shall apply to new electronic tubes. If the equipment is installed, or its installation supervised, by the Company, said one year shall run from the completion of installation provided same is not unreasonably delayed the Purchaser. The conditions of any test shall be mutually agreed upon and the Company shall be notified of may be represented at all tests that ma made. The liability of the Company to Purchaser (except as to title) arising ou the supplying of the said equipment, or use, whether on warranty, contract or n ligence, shall not in any case exceed cost of correcting defects in the equipm as herein provided and upon the expira of said one year, all such liability s terminate. The foregoing warranty does apply to any used equipment supplied un contract or any equipment supplied un contract which bears a trademark c manufacturer other than that of the Compa Because of the more restrictive warran expressed by other manufacturers, the Co pany under contract can only make av able to the Purchaser the warranty of manufacturer on all such equipment. Company will secure for the Purchaser his request copies of the manufacture standard published warranty applicable all such equipment. Used equipment is s as is without warranty unless otherw specifically provided in writing in the sa contract. The foregoing shall constitute sole remedy of the Purchaser and the s liability of the Company.

PRODUCTION CHANGE SHEET

MASTER MONITOR
MODEL 4TM21A1

REVISION A

rts List

mbol	Was	Changed To
S1	Rotary type, miniature, 4 pole, 3 position, 2 section, non-shorting. G-E Drawing B-7493816-P1.	Rotary type, subminiature, 4 pole, 3 position, 2 section, nonshorting. G-E Drawing B-7493886AB-P1.

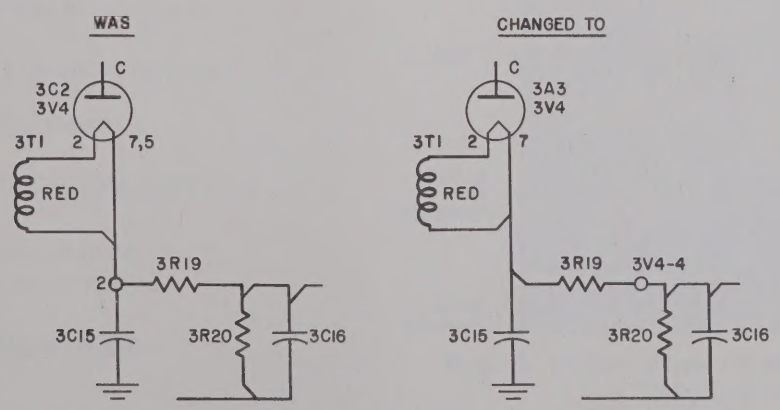
REVISION B

rts List and Elementary Diagram, Fig. 25

mbol	Was	Changed To
C16	Paper, molded plastic, 0.0047 mfd ± 20%, 400 v d-c w. Sprague Cat. #109P47204. G-E Drawing B-7491096-P25.	Paper, molded plastic, 0.1 mfd ± 20%, 400 v d-c w. Sprague Cat. #160P10404. G-E Drawing C-7778840-P33.
CR1	Germanium diode. Hughes Type 1N90. G-E Drawing C-7777146-P3.	Germanium rectifier. G-E Type 1N91. G-E Drawing C-7777664-P1.

ementary Diagram, Fig. 25

Tube 3V4 has been changed from a Type 3C2 to a Type 3A3. The circuit associated with pe 3V4 has been rewired as follows:



REVISION C

Parts List and Elementary Diagram, Fig. 21

Symbol	Was	Changed To
4CR1 and 4CR2	Germanium diodes. Hughes Type HD2051. G-E Drawing C-7777146-P18.	Silicon diodes. Hughes Type 1N629. G-E Drawing C-5494923-P5.

REVISION D

Parts List and Elementary Diagram, Fig. 21

Symbol	Was	Changed To
4C35	Not used.	Silver mica, epoxy dipped; 33 mmfd ± 5%, 500 v d-c w. Electromotive Type DM15.

INTRODUCTION

The General Electric Master Monitor, Model 4TM21A1 (Fig. 1), is designed for use in television control and transmitter rooms. The Monitor provides picture and oscilloscope presentation of the video information from a television system to which it is connected. The picture presentation is displayed on a 14-inch rectangular cathode ray tube. The oscilloscope presentation is displayed on a five-inch tube at either a horizontal or vertical rate with calibration facilities included.

Both IRE and wideband frequency response are incorporated in the oscilloscope. The wideband characteristic is such as to enable accurate examination of the 3.58 megacycle color burst in a NTSC color signal. The oscilloscope may also be used to display a commutated signal when used with a General Electric color camera channel.

TECHNICAL SUMMARY

Electrical

POWER INPUT

110/117/125 volts a-c, 50/60 cycles, 164 watts.

+280 volts d-c regulated, 580 ma.

SIGNAL INPUT

Composite or Noncomposite Video: 0.15 to 1.5 volts, optionally terminated or bridged.

Sync: $3\frac{1}{2}$ to $4\frac{1}{2}$ volts, optionally terminated or bridged.

Test Signal: 1 volt nominal, terminated (usually grating composite or noncomposite).

Oscilloscope Video: 1 volt nominal, noncomposite commutated color video, terminated.

External Oscilloscope: 20 cps sawtooth, approximately 5 volts peak-to-peak.

PICTURE HIGHLIGHT BRIGHTNESS

50 foot-lamberts minimum.

PICTURE HORIZONTAL RESOLUTION

600 lines minimum in center.
500 lines minimum in corners.

PICTURE VIDEO BANDWIDTH

10 mc ± 1 db.

PICTURE LINEARITY

± 2% of picture height, horizontal and vertical.

OSCILLOSCOPE VIDEO BANDWIDTH

Wideband: 5 mc ± 1 db.
IRE: Standard IRE roll-off.

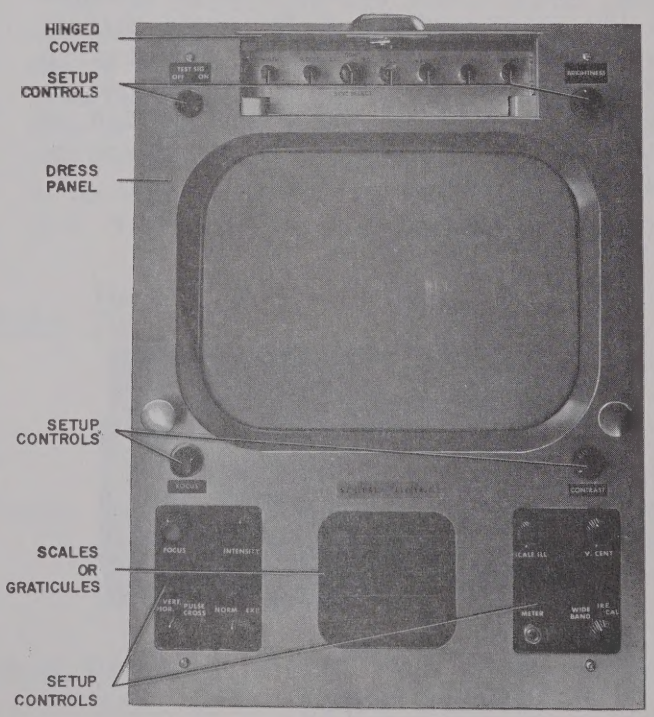


Fig. 1 Front View of Master Monitor (S61-1476)

Tube Complement

1 Type 14BAP4 (V1)
1 Type 5AMP1 (V2)
9 Type 5965 (1V1, 1V4, 2V1, 3V1, 4V1, 4V2, 5V1, 5V2, 6V1)
1 Type 6AU6 (1V2)
2 Type 6AH6 (1V3, 1V6)
1 Type 6BQ5 (1V5)
3 Type 12BY7 (2V2, 2V3, 2V4)
2 Type 6CB5 (3V2, 4V6)
1 Type 6AU4GT (3V3)
1 Type 3A3 (3V4)
2 Type 1X2 (3V5, 3V6)
1 Type 6AS6 (4V3)
3 Type 12BH7 (4V4, 4V5, 6V3)
1 Type 6080 (4V7)
1 Type 12AU7 (5V3)
1 Type 5687 (5V4)
1 Type 12AX7 (6V2)
1 Type GV6C-4000 (6V4)
1 Type OA2 (7V1)

Transistor Complement

2 Type 2N492 (5Q1, 6Q1)
1 Type 2N43 (6Q2)
1 Type 2N250 (7Q1)

Mechanical

Height:	$20\frac{1}{4}$ inches
Width:	15 inches
Depth:	20 inches
Weight:	75 pounds

DESCRIPTION

The Master Monitor consists of a main chassis on which are mounted seven plug-in subchassis, the picture tube, and the oscilloscope. The main chassis is composed of two vertical plates which are separated to support the two cathode ray tube. The 14-inch picture tube is mounted in the upper section of the main chassis and supported by an adjustable padded strap encircling it. The five-inch oscilloscope tube is located in the lower section of the main chassis and is held in place by the magnetic shield.

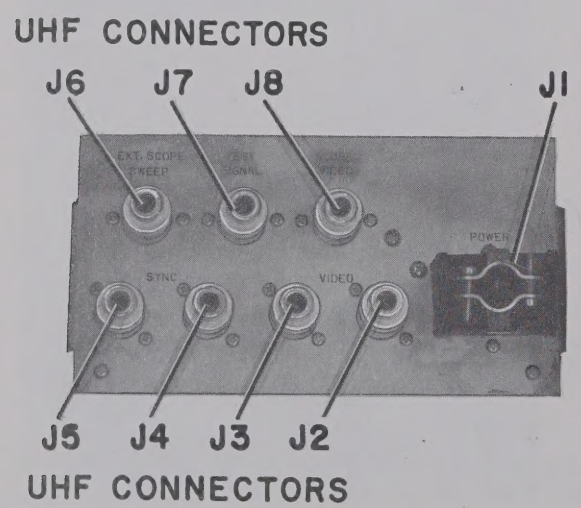


Fig. 2 Interconnection Panel (S61-1479)

A dress panel, as shown in Fig. 1, covers the front of the Monitor and is secured to the main chassis and two subchassis. The holes through which the operating controls protrude are large enough to permit removal of the dress panel without removing the control knobs. The most frequently used operating controls protrude through the front panel while a few of those less frequently used lie behind a hinged door on top of the front panel. All other controls are internally located on the appropriate subchassis and are designated by name and symbol number.

Power input connections are made to a 15-pin Jones plug while UHF connectors are used for the video and pulse circuits. These connectors are shown in Fig. 2. All of the plug-in subchassis, except the high-voltage power supply, use identical 21-pin Jones plugs which are located on the vertical side plates of the main chassis.

The high-voltage subchassis which provides the 14 kilovolts for the picture tube and four kilovolts for the oscilloscope lies flush with the top of the main chassis. The subchassis is enclosed with screening, for safety reasons, but the top section is removable for access to the high-voltage tube and circuitry. When the cover is removed, the +280-volt supply to this chassis is interrupted. The entire subchassis swings up,

itches, and remains operating to permit ccess to the yoke and picture tube area. The sweep chassis for both the picture ibe and oscilloscope are mounted on the eft side of the main chassis. The oscil-oscope and picture video chassis are mount-d on the right side of the main chassis. Two types of graduated calibration scales for insertion in the window of the oscilloscope are furnished with each Monitor. An explanation concerning their specific application is given in the OPERATION section.

The Monitor may be mounted in either a G-E Type PR-10-A Cabinet or a Type PR-1-A Rack when a Type PR-19-D Adapter is used.

INSTALLATION

General

The Master Monitor has been tested and spected before being shipped and should e ready for operation when received and stalled.

Exercise care in handling the unit to pre-ent damaging components and wiring. In-pect it for possible damage or looseness parts and connections which may have ccurred during shipment. In the event of uch damage, notify the shipping company mmediately.

Connections

The Monitor requires an a-c source of 17-volts (nominal) at 60 cps. A d-c source +280 volts at 600 ma is also required and an be supplied by the G-E Type TP-23-A r similar power supply.

Use of noncomposite video signals re-uires an external sync input for the Monitor.

If the Monitor is to be used with a color channel, provision must be made for commutated color video, 20-cycle sweep, and color relay control.

The Main Chassis Elementary Diagram, Fig. 19, shows the main chassis and subassembly interconnections and all external connections. The power and control connections are made to P1 which is furnished attached to its jack. Use wire size 16 when making the connections to P1. All signal input connections are made to coaxial connectors which are also furnished attached to their associated jacks. Coaxial cable RG-59/U is recommended for these connections.

As an installation aid, the external connections are listed in the table below. The double video and sync connections permit bridging these signals to other units. When this is done, terminate the line at its final point of use. For termination at the Monitor, a 75-ohm termination plug, similar to the G-E Type PV-9-A Plug, is recommended.

erminal Number	Function	Connect To	Remarks
P1-1	Spare		
P1-2	Spare		
P1-3	AC in	AC supply	High side of a-c supply. Set T1 and T2 transformer tap to correspond to supply voltage.
P1-4	Ground	TP-23-A, P1-8	+280 volt power supply ground.
P1-5	AC in	AC supply	Low side of a-c supply.

Terminal Number	Function	Connect To	Remarks
P1-6	External sync select	Switcher	Terminal 6 ungrounded for composite signals and grounded for non-composite.
P1-7	Spare		
P1-8	Tally light control	Switcher	Tally relay operates on 55 v d-c (24 v d-c in case of alternate 7771197P1 relay).
P1-9	Tally light control	Switcher	Tally relay operates on 55 v d-c (24 v d-c in case of alternate 7771197P1 relay).
P1-10	Spare		
P1-11	Vertical trigger		External calibration circuit.
P1-12	Color relay control	Type TC-54-A Color Channel Amplifier Console (live) P619-12 or Type TV-88-A Color Channel Amplifier Console (film) P119-6	Applying +280 v d-c to terminal #12 actuates relay.
P1-13	+280 volts	TP-23-A P1-1 or -2	B+ supply.
P1-14	2V1 bias	None	Terminals 14 and 15 normally connected together in P1.
P1-15	Oscilloscope test signal input	Test signal source	Terminals 14 and 15 normally connected together in P1.
P2	VIDEO IN	Video source	
P3	VIDEO OUT	Terminate with 75 ohms	May be bridged.
P4	SYNC IN	Sync ($4 \pm \frac{1}{2}$ volt)	
P5	SYNC OUT	Terminate with 75 ohms	May be bridged.

erminal Number	Function	Connect To	Remarks
P6	SCOPE EXT SWEEP	Type TC-54-A Color Channel Amplifier Console (live) P625 (WF MON SWEEP) or Type TV-88-A Color Channel Amplifier (film) P125 (WFM SWEEP)	20-cycle sweep.
P7	TEST SIGNAL	Grating generator output or other test signal	R11 may be opened and R12, R13 shorted to increase sensitivity.
P8	SCOPE VIDEO	Type TC-54-A Color Channel Amplifier Console (live) P610 (WF MON VIDEO) or Type TV-88-A Color Channel Amplifier (film) P110 (WFM VIDEO)	Commutated color video.

Sync Select and Plug-in Relay

The particular monitoring service to be erformed determines the setting of the SYNC ELECT switch, S3. The switch is readily accessible under the hinged cover at the top of he Monitor front panel. See Fig. 1.

When the Monitor is used with a live camera r film camera chain, external sync is supied by the synchronizing generator and witch S3 must be placed in the NON COMP osition. This type of service requires tally mp indication and relay 7K1 must be plugged nto socket 7XK1.

For applications where the Monitor is used as a switching or line output monitor in which the signals are composite, set S3 in the COMP position and insert relay 7K1 into 7XK2.

At switching locations where both composite and noncomposite signals are encountered, set S3 in the EXT position and insert 7K1 into 7XK2. This provides interlocked operation in which the switcher operates the plug-in relay for noncomposite signals.

In all applications, insert 7P10 into the socket not being used by plug-in relay 7K1.

OPERATION

Operating and Adjustment Controls and Their Functions

ICTURE TUBE FRONT PANEL CONTROLS

Control	Symbol	Function
EST SIG	S2	An OFF-ON switch to to allow mixing of such signals as grating etc., in the picture display.
FOCUS	R10	Picture tube focus control.

Control	Symbol	Function
BRIGHTNESS	R15	Picture tube brightness control.
CONTRAST	1R7	Picture tube video level control.
PICTURE TUBE CONTROLS BEHIND FRONT HINGED PANEL		
WIDTH	R1	Picture horizontal size control.
H CENT	R2	Picture horizontal centering control.
SYNC SELECT	S2	Selects sync source.
V HOLD	R3	Picture vertical synchronization control.
V CENT	R4	Picture vertical centering control.
HEIGHT	R1	Picture vertical size control.
PICTURE TUBE INTERNAL CONTROLS		
HI-LO GAIN	1S1	Picture tube coarse gain control.
AUX BRT	1R54	Picture tube brightness control for non-composite signals to establish the same background level as composite signals with the same video level.
AFC BAL	4R29	Automatic frequency set-up control.
RIGHT LIN	4R65	Picture tube right side linearity adjustment.
LEFT LIN	4R53	Picture tube left side linearity adjustment.
OUTPUT V	3R12	Regulated output voltage adjustment.

Control	Symbol	Function
OSCILLOSCOPE FRONT PANEL CONTROLS		
FOCUS	6R45	Oscilloscope focus control.
INTENSITY	6R43	Oscilloscope brightness control.
HOR-VERT-PULSE CROSS	6S1	Selects the oscilloscope sweep rate. In the PULSE CROSS position the oscilloscope display is at a vertical rate and the picture sweep circuits are switched to display the pulse cross on the picture tube.
NORM-EXP	6S2	The NORM position gives an oscilloscope display of two fields of the video signal. The EXP position gives an expanded display of the vertical or horizontal blanking region depending on the setting of 6S1.
SCALE ILL	2R55	Intensity adjustment for the edgelighted oscilloscope scale.
METER	2J2	TX-15-A Test Meter jack used for pulse amplitude calibration measurements.
V CENT	2R41	Oscilloscope vertical centering control.
WIDE BAND-IRE-CAL	2S1	The WIDE BAND position provides a 5 mc ± 1 db oscilloscope response. The IRE position provides a roll-off according to the IRE curve. The CAL position switches in a clipped sync calibrating signal.

Control	Symbol	Function
SCILLOSCOPE INTERNAL CONTROLS		
AIN	2R6	Oscilloscope vertical gain control.
-LO AIN	2S2	Oscilloscope coarse gain control.
ALI-BRATE ADJUST	2R48	Calibrating signal level control.
STIGMA-TISM	2R45	Oscilloscope astigmatism control.
ORIZON-TAL CEN-TERING	2R44	Oscilloscope horizontal centering control.
COPE V TRIG	6R9	30 cps sweep synchronization control.
COPE H TRIG	6R7	7875 cps sweep synchronization control.
ORM VIDTH	6R17	Oscilloscope sweep width control when the front panel NORM-EXP switch is in the NORM position.
XP VIDTH	6R21	Oscilloscope sweep width control when the front panel NORM-EXP switch is in the EXP position.
XP CENT	6R28	Horizontal centering control for the expanded oscilloscope display.

Picture Controls Setup Procedure

ONCOMPOSITE SIGNAL INPUT

1. Place DC switch S1 in the ON position.
2. Turn SYNC SELECT switch S3 to the ON COMP position or to EXT for external eration with P1-6 grounded.
3. Place HI-LO GAIN switches 1S1 and 2S2 to the appropriate position as determined by CONTRAST control 1R7 and GAIN control 2R6.
4. Adjust FOCUS control R10 for the sharpest picture.
5. Adjust the desired raster size with WIDTH control R1 and HEIGHT control R5.
6. Center the raster with H CENT control R2 and V CENT control R4.
7. Turn CONTRAST control 1R7 completely counterclockwise and adjust BRIGHTNESS control R15 until the raster is just extinguished.
8. Adjust the CONTRAST control for the desired picture.

COMPOSITE SIGNAL INPUT

The foregoing adjustments for noncomposite operation must be completed before making the following adjustments.

1. Turn SYNC SELECT switch S3 to the COMP position or to EXT with P1-6 ungrounded.
2. With the same picture video amplitude as in noncomposite operation, adjust AUX BRT control 1R54 for the same picture brightness. This control will need no readjustment unless the CONTRAST control (1R7) setting is changed.

PULSE CROSS DISPLAY

The pulse cross display method may be used to observe the correct pulse relationships of the sync signal. A one-foot decimal scale is required for the measurements. Fig. 3 illustrates the display observed when the sync signal is used.

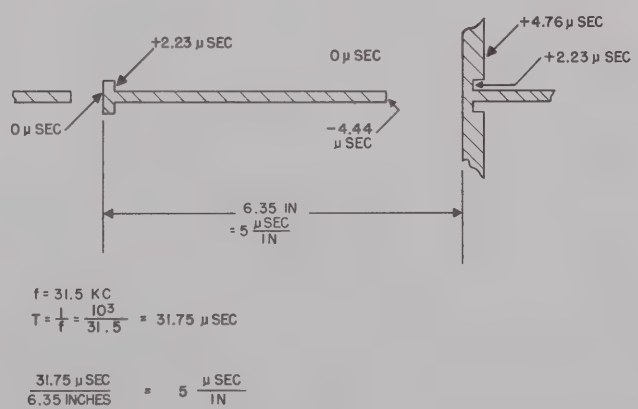


Fig. 3 Pulse Cross Display of Sync

Place HOR-VERT-PULSE CROSS switch 6S1 in the PULSE CROSS position, and adjust the horizontal size of the Monitor raster to show 6.35 inches between the starts of the equalizing pulses as shown in Fig. 3. This allows direct measurement of pulse times as a timing-to-size relationship of five microseconds per inch has been set up. The blanking and horizontal drive may be superimposed on the sync signal and will appear gray on the Monitor.

VERTICAL HOLD CONTROL (R3) SETUP

Because of the broad range over which the V HOLD control, R3, will allow the picture to remain locked-in and interlaced, the following setup procedure should be followed in order to obtain maximum vertical holding stability.

1. Reduce the picture height so that the picture will fill half the viewing screen.
2. Advance the V HOLD control, R3, clockwise until the picture starts to jitter. Reset the V HOLD control counterclockwise to a position just beyond the point where the picture jitter stops.

Oscilloscope Controls Setup Procedure

1. Place DC switch S1 in the ON position.
2. Adjust INTENSITY (6R43), FOCUS (6R45), ASTIGMATISM (2R45), and H CENT (2R44) for optimum display of the waveform.
3. Place the HOR-VERT-PULSE CROSS switch, 6S1, in the HOR position and adjust SCOPE H TRIG (6R7) for a stable display.
4. Place 6S1 in the VERT position and adjust SCOPE V TRIG (6R9) for a stable display.
5. Adjust NORM WIDTH (6R17) for the desired width.
6. Place the NORM-EXP switch, 6S2, in the EXP position and adjust the EXP WIDTH control, 6R21, and the EXP CENT control, 6R28. Note that a small adjustment of the SCOPE H TRIG or SCOPE V TRIG may be necessary to exactly center both displays.
7. Adjust the V CENT control, 2R41, so that the waveform black level is even with the scale zero.

Oscilloscope Calibration Setup Procedure

1. Insert the Type TX-15-A Test Meter into METER jack 2J2.
2. Place the WIDE BAND-IRE-CAL switch, 2S1, in the CAL position.
3. Turn CAL ADJ (2R48) so that the desired calibration voltage is read on the 0-3 scale of the meter.
4. When the meter is unplugged, the amplitude of the clipped sync pulse, as viewed on the oscilloscope, will be of the same amplitude as the voltage read on the meter.
5. Adjust V CENT (2R41), GAIN (2R6), and HI-LO GAIN (2S2) so that the pulse fills the 0-100 space on the scale.
6. Place 2S1 in the WIDE BAND or IRE position.

The incoming signal may be read as a proportion of the calibration signal. The GAIN (2R6) and CAL ADJ controls should not be moved unless a recalibration is necessary. The Type TX-15-A Test Meter may be plugged into the METER jack, 2J2, at any time to check the calibration voltage.

Oscilloscope Scales

Two engraved scales or graticules, one video type and one RF type, shown in Fig. 1, are furnished for use with the oscilloscope. The Monitor is shipped with the video scale installed. The transmitter RF scale should be installed on Monitors intended for transmitter monitoring applications.

The scales are arranged so that when the Monitor input levels are pre-set to display equal amplitudes between blanking level and reference white, the monitor calibration is the same for either a true video signal or a demodulated RF signal. Blanking level is zero on the IRE video scale and 75% of peak signal on the RF scale. Reference white is 100 on the video scale and 12.5% on the RF scale. EIA standard maximum depth of modulation is 12.5% ± 2.5%. Zero RF level corresponds to 120 on the video scale.

The scales are edge lighted for maximum legibility. Dimming of the edge lighting is controlled by SCALE ILL (2R55).

THEORY AND CIRCUIT ANALYSIS

General

The Master Monitor consists of seven functional subchassis, mounted and plugged into the main chassis frame. In addition to supporting the individual subchassis, the main chassis contains their receptacles and interconnecting wiring along with the power transformers, horizontal sweep transformer, picture tube, oscilloscope tube, deflection yoke, fuses, tally lamp, input connectors, relay, and certain controls.

The circuits of the Monitor are discussed by subchassis function and in the following order:

Main Chassis
Picture Video Amplifier
Picture Horizontal Sweep
Picture Vertical Sweep
Oscilloscope Video Amplifier
Oscilloscope Sweep
High-Voltage Power Supply
Bias-Centering-Relay

Refer to the Over-all Block Diagram, Fig. 4, and to the appropriate Elementary Diagram for each subchassis.

Main Chassis

Refer to Figs. 5, 6, and 19.

Power transformers T1 and T2 are identical and are mounted in the lower left and right portions of the main chassis. Three primary taps, 110, 117, and 125 volts are provided. The Monitor is shipped connected

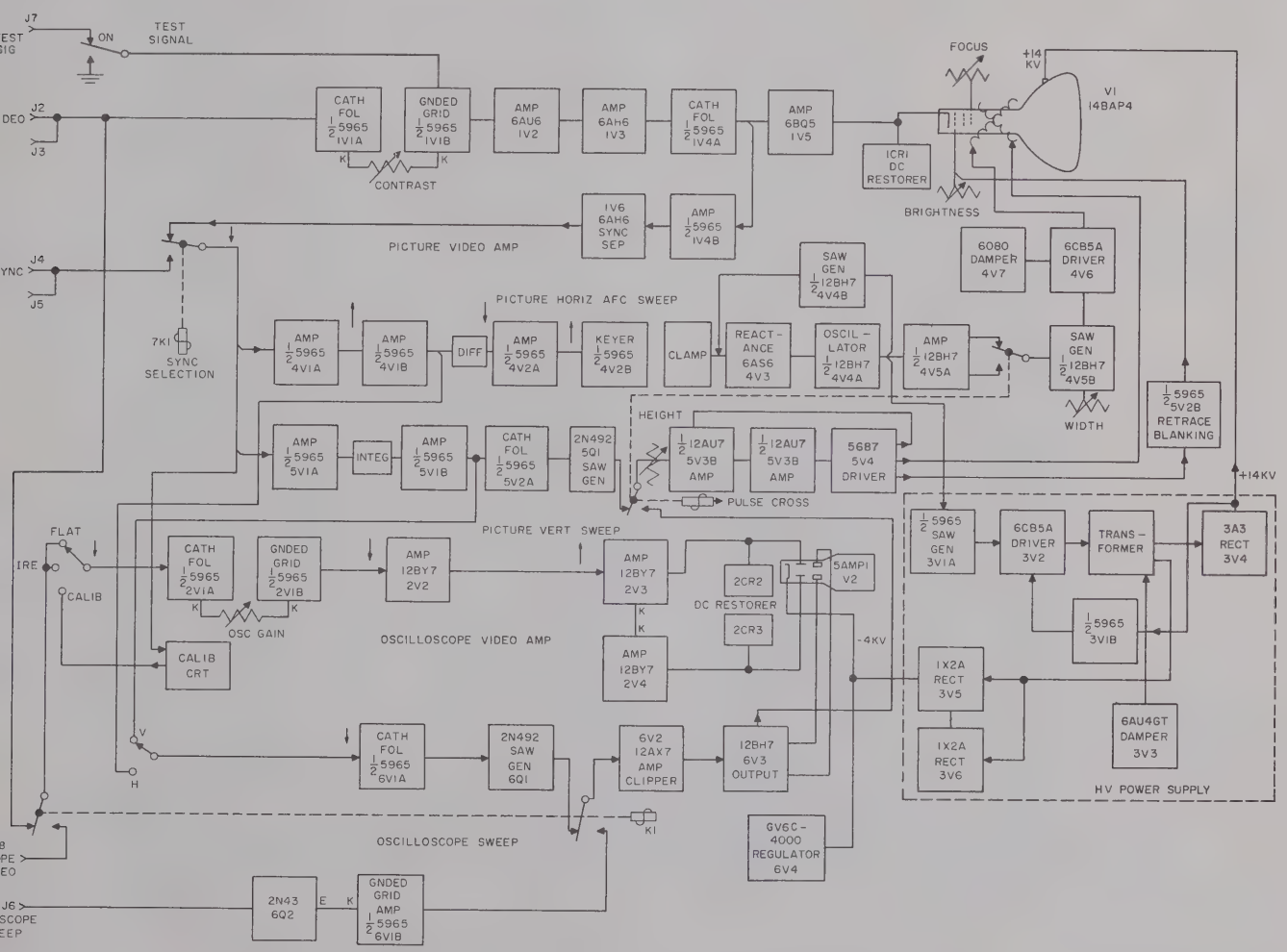


Fig. 4 Over-all Block Diagram (C-7778342, Rev. B)

for 117 volts but the appropriate taps should be used for other line voltages. Each transformer has three 6.3-volt filament windings and a 100-volt plate winding. The plate windings are series connected to supply 200 volts a-c for the bias circuit in the bias-centering-relay chassis.

The horizontal sweep transformer is mounted within the main frame for shielding and safety. The transformer is part of the picture horizontal sweep subchassis and is discussed in that section.

The picture tube is an aluminized, high resolution, electrostatically focused 14-inch unit designed especially for monitor service. It is secured to the main chassis by two flexible clamps which grip the front of the bell. Regulated +14 kilovolts from the high-voltage power supply is connected to the side anode connector. The remainder of the connections are made to the socket.

A Type 5AMP1 cathode ray tube employing the mono-accelerator principal is used for the oscilloscope display. Regulated -4 kilovolts is used as the acceleration potential. Connections are made to both the base and the tube neck. Since the oscilloscope circuits are contained on several chassis, a simplified schematic of these circuits is included. See Fig. 7.

The deflection plates and the accelerator anode are operated at near ground potential. The ASTIGMATISM control, 2R45, adjusts the accelerator potential to equal the average

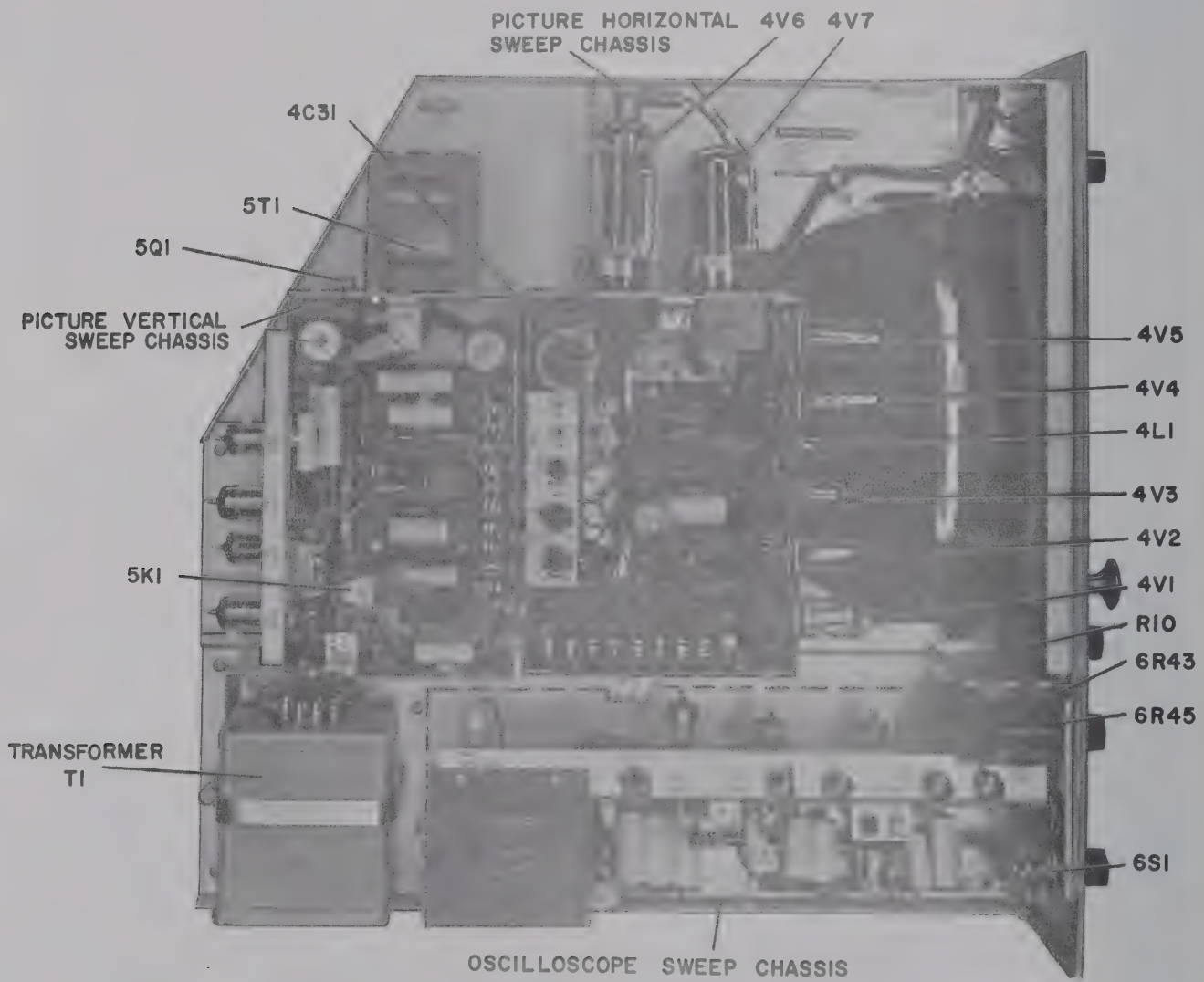


Fig. 5 Left Side View (S61-1477)

tential of the deflection plates to establish arp over-all focusing.

Negative high voltage in excess of -4 lovolts is obtained from the high-voltage wer supply and applied to the INTENSITY ntrol, 6R43. The other end of 6R43 is con- cted to a Type 6V6-4000 corona regulator V4) providing a nominal regulated voltage 4000 ± 100 volts. The regulated voltage applied to the oscilloscope cathode through R42. The voltage on the arm of 6R43 is ore negative than the cathode potential and pplies a negative potential to grid #1 (pin 3) the oscilloscope. Focusing is accomplished supplying a potential to the focusing elec- ode (pin 5) that is positive with respect the -4 kilovolt cathode potential.

Retrace blanking is obtained by differ- tiating the sweep voltage and applying e resulting pulse to grid #1.

The deflection yoke, L1, contains low impedance parallel wound horizontal coils to insure optimum flux distribution. The yoke is secured to the picture tube neck by a single screw clamp.

Both the a-c and d-c fuses and the d-c switch are located inside the Monitor in the upper right portion. The d-c fuse, F1, protects the incoming 280-volt line. Both the 280-volt line and the internally generated -150 volt line are connected to the d-c switch.

Picture Video Amplifier Subchassis

Refer to Figs. 6 and 20.

The picture video signal connected to the video input jack, 1J2, is capacitively coupled to the grid of the first video amplifier, 1V1A. 1V1A is a cathode follower direct coupled

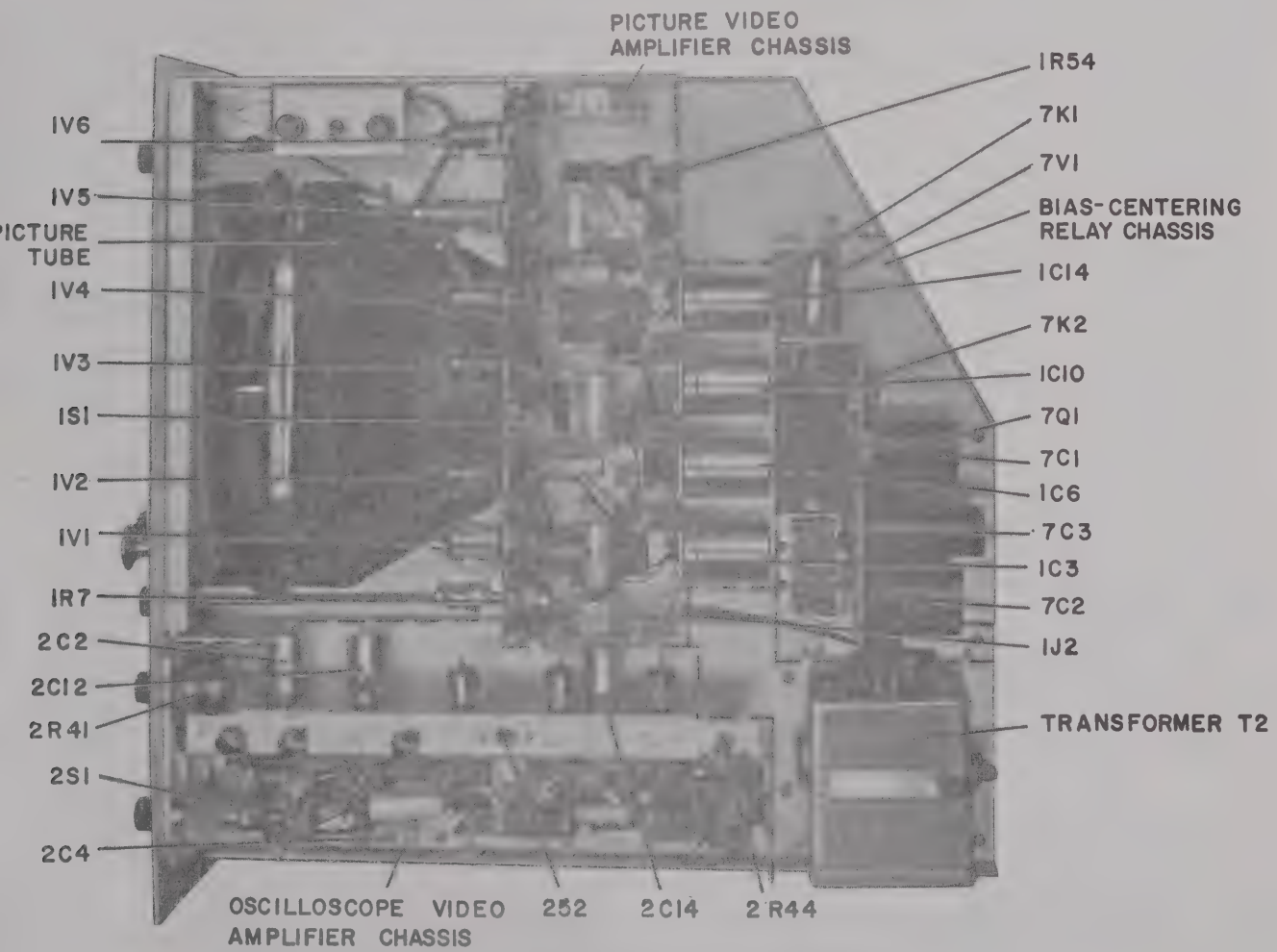


Fig. 6 Right Side View (S61-1478)

through CONTRAST control 1R7 to 1V1B, a grounded grid amplifier. Since the two ends of the CONTRAST control are at the same d-c potential, no d-c surge is generated. The CONTRAST range is approximately 5 to 1. When the TEST SIGnal switch, S2, is on the ON position, a signal is coupled to the grid of 1V1B and mixed with the picture video signal.

The output of 1V1B is capacitively coupled to the grid of video amplifier 1V2 which is series shunt compensated by 1L3, 1L4 and cathode degenerated by 1R18, 1R19. Low-frequency response is maintained by the special compensating network which includes the coupling circuit to the grid of 1V3.

1V3 is similar to 1V2 but has more gain and voltage handling capability due to its comparatively large load resistor, 1R37, which is permitted by the low shunt capacity input of cathode follower 1V4A. The cathode degeneration and, therefore, the amplifier gain of 1V2 and 1V3 is changed by GAIN switch 1S1. Normally, this is a set-up control and takes care of the very wide range of input signals which the Monitor will accept.

Cathode follower 1V4A provides two outputs. One output drives the video output stage, 1V5. This stage is series shunt compensated by 1L8 and 1L9 and highly degenerated by 1R44. Diode 1CR1, the d-c restorer, conducts during the most positive part of the video output signal. The d-c restorer is returned to ground when a noncomposite signal is used or to an adjustable positive voltage when the signal includes sync. The AUX BRT control,

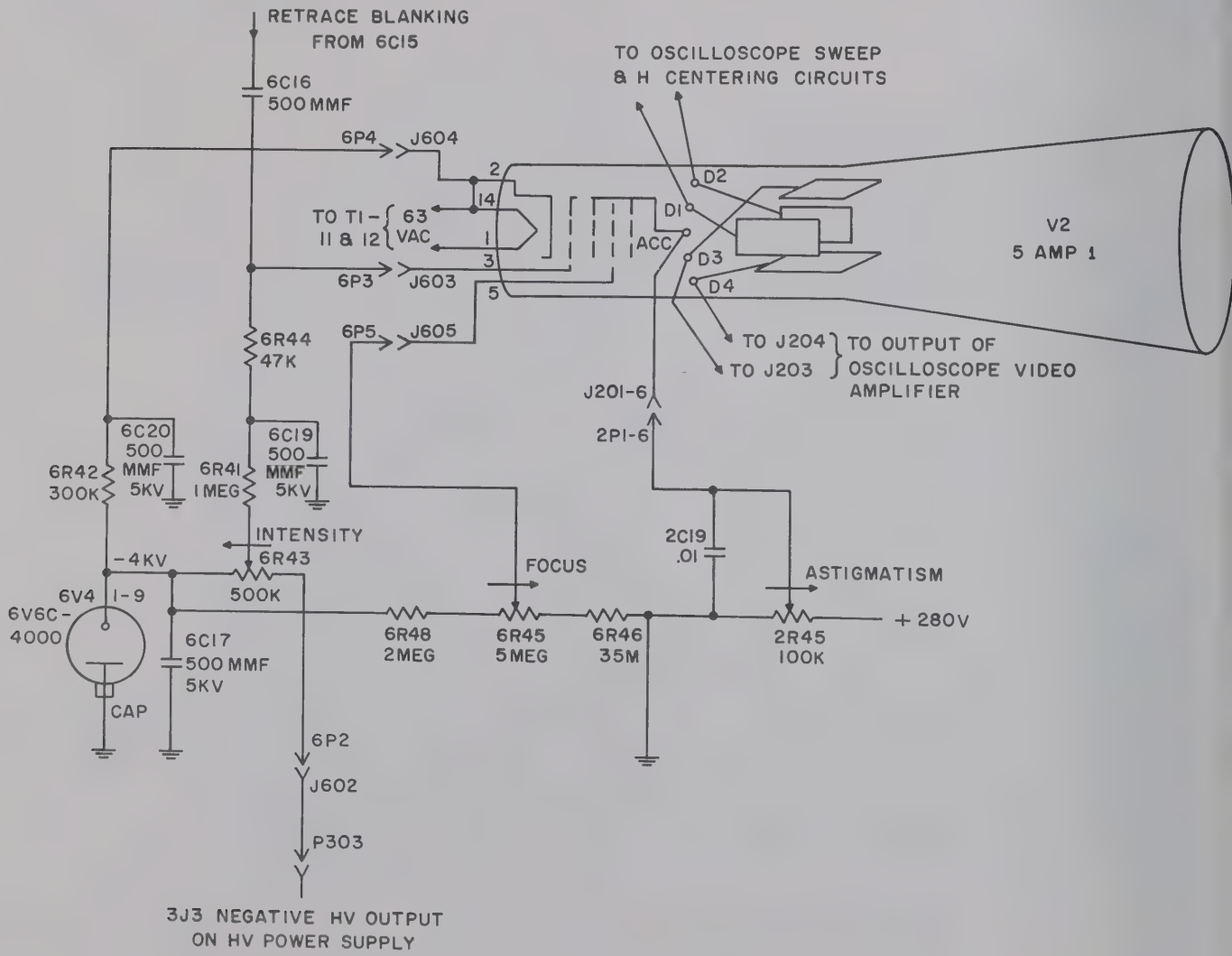


Fig. 7 Simplified Elementary of Oscilloscope Circuit

R54, allows adjustment of this positive oltage to compensate for the variable sync mplitudes encountered. Note that an in-ease in the positive voltage increases bias nd decreases brightness since it is oper-ing on the picture tube cathode. Coupling apacitor 1C13 is large enough to prevent ny appreciable discharge by picture tube eam current. The charge on 1C13 is replaced very line by the conduction of the d-c re-orer diode, 1CR1.

The other output of 1V4A is amplified by V4B which in turn drives the sync separator age, 1V6. The sync separator action is il-strated in Fig. 8. 1V6 is operated at a low creen potential in order to obtain a low grid utoff voltage. The grid driving voltage is a omparatively high level sync positive video gnal. The positive sync peaks are held at ero voltage by the grid to cathode diode ac-on of 1V6 causing the video portion of the gnal to be held below cutoff. The negative oing clipped sync appears at the plate of V6, coupled through 1C11 to terminal 10 1P1 and interconnected to the bias-center-g-relay subchassis. The gain of this sync eparator is such that the CONTRAST set-ng which provides a usable picture also lows clean sync clipping.

Picture Horizontal Sweep Subchassis

Refer to Figs. 5 and 21.

Incoming sync from pin 2 of sync relay 7K1 on the bias-centering-relay subchassis is coupled to the grid of 4V1A where it is inverted, amplified, and differentiated by network 4C2-4R5. The signal is then coupled through 4C4 to the grid of 4V1B where it is again amplified and inverted. The negative going pulse output of 4V1B is used both to trigger the oscilloscope sweep (pin 7 of 4P1), and after further differentiation, to drive the amplifier stage, 4V2A. The narrow positive going pulse output from 4V2A is applied to keyer tube 4V2B. The equal plate and cathode resistors of 4V2B produce equal negative and positive pulses that are applied to clamp diodes 4CR1 and 4CR2 respectively.

AUTOMATIC FREQUENCY CONTROL (AFC)

The horizontal sweep is timed by oscillator tube 4V4A, the frequency of which is determined primarily by 4L1, 4C18, 4C19 and the effective reactance of reactance tube 4V3. The a-c plate voltage of 4V3 is the voltage of 4L1. The suppressor grid voltage of 4V3 is determined by the voltage across 4R36 which is substantially 90 degrees out of phase with the plate voltage. The magnitude of the plate current is determined by the d-c voltage on the control grid. In this manner 4V3 functions as a reactance across 4L1, the magnitude of the reactance being determined by the d-c voltage on the grid of 4V3, thus, controlling the frequency of the horizontal oscillator.

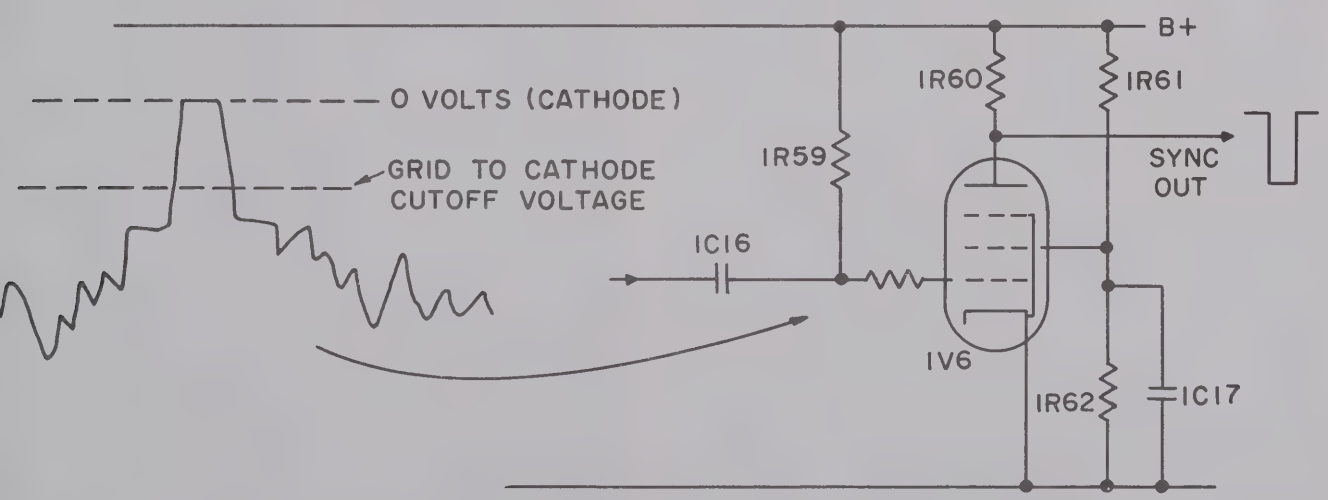


Fig. 8 Simplified Elementary Showing Sync Separator Action

Output from the horizontal oscillator (4V4A) cathode circuit drives 4V4B into conduction, discharging capacitor 4C24, which then recharges when 4V4B ceases to conduct, thus, generating a sawtooth waveform. This sawtooth is applied to clamp 4CR1-4CR2. The pulses applied to 4CR1 and 4CR2 are timed to bring the diodes into conduction for a short interval during the retrace time of the sawtooth. Thus, the d-c voltage developed at the grid of 4V3 depends upon the position on the sawtooth retrace where the diodes are brought into conduction by the keying pulses. Therefore, if the incoming pulses and the generated sawtooth are in synchronism, a constant d-c voltage will be developed at the grid of 4V3. If the frequencies start to differ, the pulse will occur at a different point on the sawtooth retrace, and the d-c voltage on the grid of 4V3 will change in such a direction as to bring the frequency of the horizontal oscillator back into synchronism with the incoming sync. In this way horizontal synchronism is maintained.

Normally, 4V5A serves to couple the output of the horizontal oscillator, 4V4A, to 4V5B. In a like manner to 4V4B, a sawtooth waveform is generated in 4V5B. In addition, 4R53 adds a pulse to the sawtooth.

DEFLECTION

The horizontal deflection system is of the high efficiency energy recovery type, with 4V6 as the sweep driver and 4V7 as the triode grid-controlled damper tube. A current increasing uniformly with time (a sawtooth current) will be established in a resistanceless inductance if a constant potential is maintained across the deflection yoke horizontal coils. Since these coils have unavoidable resistance, it is necessary to add to the constant potential a component of voltage sawtooth in shape. This is accomplished by the sweep driver tube, 4V6, and the horizontal output transformer, T3.

When the beam on the picture tube is just left of center, conduction is initiated by the applied modified sawtooth (sawtooth plus pulse waveform) generated in 4V5B crossing the self-bias generated at the signal grid of 4V6. The uniformly increasing current thus established in the horizontal deflection coils, connected to the transformer secondary, sweeps the beam to the right-hand edge of the picture tube. At this instant, the pulse component of the grid driving wave of 4V6 cuts the tube off with extreme rapidity. Simultaneously, the entire system of deflection coils, transformer, and associated capacities of circuits and tubes operates as a freely oscillating system at a fundamental frequency determined by the total L and C, and with the total energy stored in the magnetic fields of the inductive branch.

At the start of this oscillation the current in the deflection coil had built up to its maximum positive value. Hence, as the oscillation starts, with the collapse of the magnetic fields, the potential at the top of the deflection coil goes in a negative direction. During the first quarter cycle of this free oscillation the energy goes into the capacitive branch of the system, and during the second quarter cycle the energy goes back into the inductive branch, but the current direction is now reversed. As the current in the deflection coil decayed to zero, the beam went back to center; and as the current built up in the opposite direction, the beam was pulled to the left-hand edge. Since this half-cycle of oscillation, constituting flyback, occurred in less than microseconds, the fundamental frequency of self oscillation of the system is over 50,000 cps.

At the completion of the first half cycle of self oscillation the potential at the top of the deflection coil, having gone to some several thousand volts negative and returned to its former value, will now attempt to swing more positive. But this is prevented by damper tube 4V7 going into very rapid conduction as a result of the suddenly increasing positive voltage at the plates and the differentiation of this positive going voltage being applied to the control grids. This rectification charges 4C34. Thus, the positive swing of the free oscillation is arrested with the beam at the left-hand edge of the picture tube, with the full complement of energy stored in the magnetic field but in an opposite sense. The decay (at a uniform rate) of the current in the deflection coil, with the beam progressing from left to center, is accomplished by the damper control of

the potential across the yoke. When the beam approaches just left of center, conduction in the driver tube begins again and the cycle is repeated. Since the B+ voltage for the driver tube is in series with the transformer secondary, power feedback is obtained and the 280 volts B+ is boosted to approximately 480 volts.

In the above discussion the HOR-VERT-PULSE CROSS switch, 6S1, was assumed to be in either the HOR or VERT position so that the pulse cross relay, 5K1 (located in the picture vertical sweep subchassis), is not operated and the pulse used to initiate the horizontal deflection came from the cathode of 4V5A. Because of the tuned circuit in the plate circuit of 4V5A, this pulse is approximately 90 degrees out of phase with the cathode voltage. When the HOR-VERT-PULSE CROSS switch is in the PULSE CROSS position, the horizontal sweep is delayed approximately 90 degrees which brings the horizontal blanking interval near the middle of the picture tube for pulse cross display.

Horizontal centering is provided by the H CENT control, R2, which varies the d-c current in the horizontal coils of the deflection yoke.

Picture Vertical Sweep Subchassis

Refer to Figs. 5 and 22.

The vertical sweep circuit provides a sawtooth of current to the deflection yoke for vertical scanning of the picture tube. Synchronization is obtained from the negative sync obtained from the sync relay, 7K1. Amplification and inversion is accomplished in 5V1A which feeds a three-stage integration network. This network output provides a rapidly rising, positive pulse whose start corresponds to the beginning of the vertical serrated pulses. This vertical rate pulse is then amplified in 5V1B which is biased so that remnants of the horizontal sync are below cutoff and do not appear in the output. The resulting negative pulse is used to trigger the sawtooth generating circuit consisting of 5V2A and 5Q1.

This pulse is also used to synchronize the 30-cycle sweep in the oscilloscope sweep subchassis. A sawtooth output is taken from the oscilloscope sweep and, together with the 60-cycle sawtooth output of 5Q1, are the two inputs to relay 5K1. For normal picture display, the signal of 5Q1 is selected and for pulse cross display, the 30-cycle sawtooth causes the vertical blanking to appear as a horizontal band across the center of the raster.

5Q1 is a unijunction transistor and generates the sawtooth voltage. The unijunction transistor is a three-terminal transistor which has electrical characteristics that are quite different from those of conventional two-junction transistors. Its most important feature is its highly stable negative resistance characteristic. Briefly, its emitter impedance remains very high at emitter to base #1 voltage which is less than a critical voltage of approximately 0.6 of the base #1 to base #2 voltage. The emitter to base #1 impedance becomes very low when this critical voltage is exceeded. Capacitor 5C9 charges through 5R16 and R3 (V HOLD) toward +280 volts producing a sawtooth voltage. At the time capacitor 5C9 has charged to a voltage just below the critical voltage for self-triggering, the vertical trigger lowers the base to base voltage and initiates the discharge of 5C9 through the emitter to base #1 impedance and coil 5L1.

A high degree of linearity is achieved in the sawtooth amplifier and output stages 5V3 and 5V4 due to two negative feedback loops. One loop feeds a voltage proportional to the yoke current back to the cathode of 5V3A. The other loop is voltage feedback from 5V3B output to 5V3A plate. Compensation for non-linearities in the system is performed by the network comprised of 5C14, 5R25, and 5C15. The HEIGHT potentiometer is interposed between 5K1 and the input to 5V3A and controls the sweep size.

Centering control is provided by the V CENT control, R4, which introduces regulated centering current, generated in the bias-centering-relay subchassis, into the vertical coils of the deflection yoke.

The yoke voltage is differentiated to remove the sawtooth portion, leaving only the pulse. This pulse is amplified and shaped in 5V2B to provide a clean negative pulse which is fed to the picture tube grid to provide vertical retrace blanking.

Oscilloscope Video Amplifier Subchassis

Refer to Figs. 6 and 23.

The picture video signal is capacitively coupled through 2C1 to the first video amplifier 2V1 when 2S1 is in either the WIDE BAND or IRE position. The CALibrate position of 2S1 is discussed further on in this section. The first half of 2V1 is a cathode follower direct coupled through the GAIN control, 2R6, to the second half which is a grounded grid amplifier. Since the two ends of the GAIN control are at the same d-c potential, no d-c surge is generated.

The series shunt peaking coil, 2L1, provides an essentially flat frequency response when 2S1 is in the WIDE BAND position. In the IRE position of 2S1, the frequency response is modified by 2C4, 2L3, 2C5, and 2R11 to conform to the standard IRE curve.

The grid of 2V1B is normally a-c grounded but a test signal may be coupled to this point if desired. A link is provided on the main power input plug (across P1-14 and -15) for this purpose.

The output of 2V1B is coupled to 2V2 through capacitor 2C6. The use of series-shunt coils 2L5 and 2L6 introduce high-frequency compensation to insure optimum bandwidth. The maximum gain of the amplifier can be varied in two steps (HI or LO) by the use of GAIN switch 2S2 which changes the cathode degeneration of 2V2. This is normally a setup adjustment.

The signal from 2V2 drives output pentodes 2V3 and 2V4 which constitute the cathode coupled output amplifier. The control grid of 2V4 is a-c grounded by 2C13 and the resulting plate output signal is of the same amplitude but inverted with respect to 2V3. Both 2V3 and 2V4 are series-shunt peaked and coupled to the vertical deflection plates of the cathode ray tube by 2C16 and 2C17.

Diodes 2CR3 and 2CR4 are d-c restorers which maintain the blackest portions of the video signal at the same potential as the two arms of the V CENT control, 2R41. Coils 2L11 and 2L12 present a high impedance to 3.58 megacycles, thus, preventing squashing of color bursts and the subcarrier.

The dual V CENT control, 2R41, permits varying the potential difference symmetrically around that of the cathode ray tube accelerator anode.

The ASTIGMATISM control, 2R45, allows adjustment of the accelerator anode voltage to aid in establishing a sharp over-all focus. Normally, once the control has been set up, no further adjustment is necessary unless the cathode ray tube is changed.

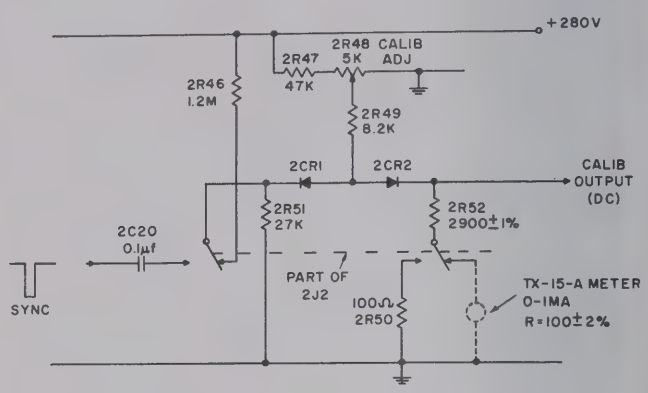


Fig. 9 Simplified Elementary of Calibration Circuit

Accurate amplitude measurement of the video signal is made possible by use of the calibration circuit. The calibrating signal consisting of clipped sync is applied to the oscilloscope video amplifier input when 2S1 is placed in the CALIB position. See Fig. 9. Plugging the Test Meter, Type TX-15-A, into the CALIB METER jack, 2J2, applies a d-c voltage from CALIB ADJ 2R48 across 2CR2, 2R52 and the meter resistance. At the same time a connection to 2R46 biases diode 2CR1 so that it does not conduct. 2R52 and the meter resistance total at 3000 ohms so that the meter current in milliamperes is equal to the d-c voltage across 2R52 and the meter resistance divided by three. Since the instrument is 0-1 ma with a 0-3 scale, the voltage may be read directly.

In use the CALIB ADJ is set for a desired meter reading and then the meter is removed. The contacts of 2J2 return to their normal position and connect a 100-ohm resistor in the circuit as a substitute for the meter resistance. The bias is also removed from 2CR1 so that it is free to conduct and negative sync is applied through 2C20 to the junction of 2CR1 and 2R51.

During the time between sync pulses, 2CR1 is cut off by the charge on 2C20 and the cur-

rent through 2R52 and 2R50 causes the resulting output voltage. During the negative pulse interval, diode 2CR1 conducts and places the common anode connection at the sync pulse tip voltage by increasing the current through 2R49. When the anode voltage of 2CR2 becomes less than its cathode voltage, the diode is cut off and the output drops to ground (zero) potential. Consequently, the output has the general shape of the sync pulse and the amplitude varies precisely between ground and a pre-selected d-c level.

Oscilloscope Sweep Subchassis

Refer to Figs. 4 and 24.

Synchronizing triggers for the oscilloscope sweep are obtained from 4V1B of the picture horizontal sweep subchassis and 5V1B of the picture vertical sweep subchassis and are selected by the HOR-VERT-PULSE CROSS switch, 6S1.

The sawtooth generator consists of 6V1A and 6Q1 and operates in a manner similar to 5V2A and 5Q1 of the picture vertical sweep subchassis. However, instead of operating at the horizontal or vertical trigger rate, the time constants of the unijunction transistor are selected so that only every other pulse reduces the base #2 to base #1 voltage sufficient to cause triggering. Consequently, the output of the sawtooth generator is 7875 cycles or 30 cycles depending on the setting of 6S1. When 6S1 is in the HOR position, the time constant network consists of 6C4, 6R8, and the SCOPE H TRIG, 6R7. When in the VERT or PULSE CROSS position, the network consists of 6C5, 6R10 and the SCOPE V TRIG, 6R9. In each case the free running frequency is slightly less than the desired output frequency. The neon lamp across each charging capacitor prevents the voltage on the capacitor which is not being used in the sawtooth generator circuit from exceeding 60 volts. This prevents possible damage to the unijunction transistor.

When the NORM-EXPAND switch, 6S2, is placed in the NORM position, 6V2A operates as a cathode follower furnishing a NORMAL WIDTH adjustment, 6R17. In the EXPAND position of 6S2 both sections of 6V2 comprise a cathode coupled clipper which removes the top and bottom portion of the deflection sawtooth and then amplifies the remaining signal. The center of the sweep interval is deflected at a very rapid rate, thereby, expanding the desired portion of the signal several times. The EXPAND WIDTH control, 6R21, allows horizontal width adjustment of the cathode sawtooth trace. Precise centering of the expanded portion of the signal is provided by the EXPAND CENTERING control, 6R28.

Output stage 6V3 is cathode coupled to provide a push-pull output for the deflection plates of the oscilloscope cathode ray tube. The a-c output voltages are coupled to the horizontal deflection plates through 6C12 and 6C13. The d-c potential of the deflection plates are set by the balanced HOR CENTERING control, 2R44, which is located on the oscilloscope video amplifier subchassis.

When operated in conjunction with a G-E Color Channel Amplifier, Type TV-88-A or TV-94-A, sequential presentation of the red, blue, and green signals is made possible. When the color display is required, a 20-cycle sawtooth input to 6V2 is selected by relay K1 which is operated from the color control panel. In addition, the color channel amplifier furnishes a sequential video signal to the oscilloscope video amplifier.

6Q2 and 6V1B provide amplification of the 20-cycle sawtooth waveform input without inverting it. Transistor 6Q2 operates as an emitter-follower and drives the grounded grid stage, 6V1B.

High-Voltage Supply Subchassis

Refer to Figs. 10 and 25.

The high voltage for both the picture and oscilloscope cathode ray tubes is obtained from the high-voltage power supply subchassis.

The regulated high voltage is obtained from a 15.75-kc synchronous flyback circuit somewhat similar to the horizontal deflection circuit. The output of the AFC oscillator, 4V4A, on the picture horizontal sweep subchassis, is fed to the sawtooth generator, 3V1A, and is in turn coupled to the grid of the driver stage, 3V2. The deflection yoke in this case is replaced by a tunable storage

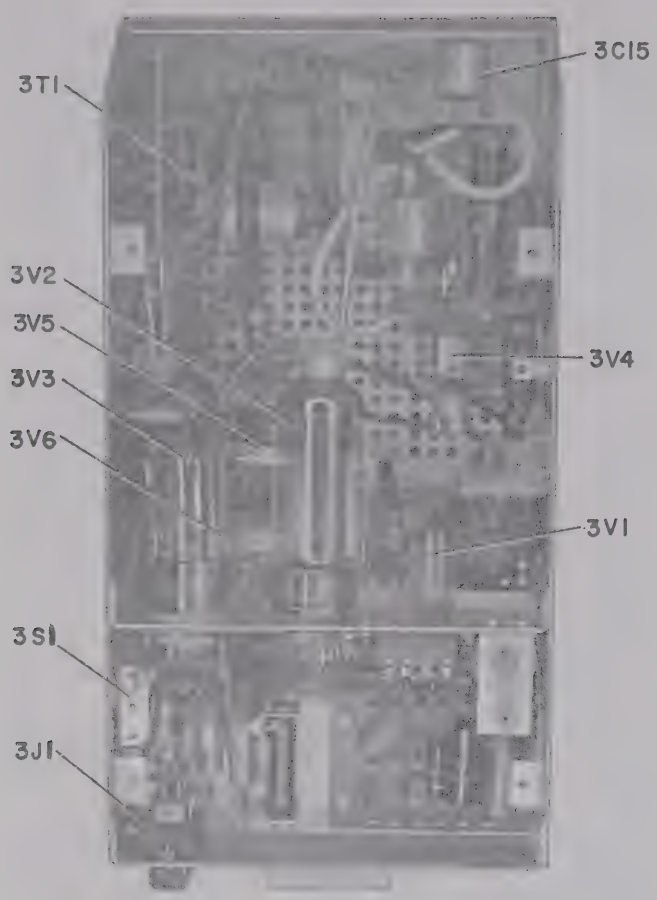


Fig. 10 High-Voltage Power Supply (S61-1480)

coil, 3L1. The boosted voltage rectified by diode damper 3V3 is as much as 600 volts. Transformer 3T1 is equipped with an extended winding so that the retrace pulse from the storage coil is stepped up to over 15,000 volts. The voltage from the extended winding is rectified by 3V4 and filtered by 3C15 and 3R19. The d-c output is divided down through the 250-megohm resistor, 3R20, to the grid of the regulator control tube, 3V1B. The plate output voltage of 3V1B controls the bias on the driver tube and is referenced back to -150 volts through neon lamps 3I1, 3I2, and 3I3. The output voltage is set with the HV ADJ control, 3R12, which sets the reference level for the regulator circuit. Normally, this is set for +14 kv at the picture tube anode.

The positive pulse at the driver anode is also rectified in the voltage doubler circuit, 3V5 and 3V6, resulting in a d-c output of approximately -4 kv.

Filament voltage for 3V4, 3V5, and 3V6 is obtained by inductive coupling to the flux in the core of 3T1.

Bias-Centering-Relay Subchassis

Refer to Figs. 6 and 26.

Several small unrelated circuits are grouped on the bias-centering-relay subchassis.

BIAS

The bias circuit consists of the bridge rectifier, 7CR1, 7CR2, 7CR3, and 7CR4, together with a three-section RC filter and a gas filled voltage regulator tube, 7V1. This produces a low ripple regulated -150 volt supply used throughout the Monitor.

CENTERING

The bridge circuit comprised of 7CR9, 7CR10, 7CR11, and 7CR12 rectifies the 6.3 volt centering supply. This is filtered by 7C2 and applied to the collector of power transistor 7Q1. The transistor operates as an emitter follower with base voltage referenced by zener diode 7CR13. The output voltage is taken from the emitter and is about 0.2 volt less than the approximate five-volt base voltage.

This provides a regulated low voltage, high current (about one ampere) supply for use in the picture vertical centering circuit.

RELAY

Two relay sockets (7XK1, 7XK2), one plug-in relay (7K1) and one plug (7P10) are provided. For camera control applications of the Monitor, relay 7K1 is used to control the camera tally lamp and is to be inserted into socket 7XK1, and plug 7P10 into socket 7XK2. When the relay is energized, the tally lamps are supplied with 6.3 volts a-c through the relay contacts. The standard relay supplied has a 6500-ohm coil and is designed to operate at 55 volts d-c which is supplied by the camera switcher.

Normally the 55 volts is obtained by

adding sufficient dropping resistors in series with the +280 volts line. In no case should the coil voltage exceed 60 volts.

A 24-volt relay may be ordered for switching systems using 24-volt control. Order it by G-E Drawing C-7771197-P1.

When the Monitor is used as a master or switching monitor, relay 7K1 is inserted into socket 7XK2, and plug 7P10 into socket 7XK1. In this position, the relay performs the necessary functions for changing from composite to noncomposite signal operation. It is controlled by SYNC SELECT switch S3 of the main chassis. When the SYNC SELECT switch is turned to the EXT position, external control may be performed by grounding input terminal P1-6 when noncomposite operation is desired.

In noncomposite operation, obtained by energizing the relay, the station sync is routed from the sync input connector, J4 or J5, to the sweep and calibration circuits.

MAINTENANCE

Preventive

To obtain maximum life and proper operation from the Master Monitor, a regular preventive maintenance schedule should be followed.

INSPECTION

Look for evidence of component overheating such as discoloration of resistors or wiring. Feel transformer cases for overheating. Check for bulging sides or discolored paint. On electrolytic capacitors, look for evidence of corrosion or bulging. On oil-filled capacitors, look for oil leaks. Check tubes for low emission or noisy operation. Replace any questionable component.

RECORDS

Where feasible, record operating current and voltage readings of tubes at regular intervals. These records are an excellent basis from which to predict tube life and plan future tube replacements.

CLEANING

Keep the equipment as clean and dry as possible. An air blower or a brush with long soft bristles makes a very good dust remover. When a high pressure air hose is used for cleaning, care should be taken not to disturb components or wiring.

The high potentials used in the regulated high-voltage power supply attract dust particles necessitating a more frequent cleaning schedule. The parts to be cleaned may be reached by removing the interlocked cover.

CAUTION

To prevent the possibility of shock from stored charge, ground the anode lead of the picture tube before attempting to clean the high-voltage power supply.

COMPONENT REPLACEMENT

Before installing the replacement part, check the circuit for the cause of the component failure. When replacing components, select the proper replacement part from the Parts List. All components are listed by symbol number and have their G-E Drawing number and a complete description given.

Corrective

REALIGNMENT PROCEDURES

1. Test Equipment Required

a. Marka-Sweep sweep generator or equivalent (flat to 12 mc.)

b. Wideband oscilloscope (Tektronix Type 524D or Hewlett-Packard Type 150A) with high impedance probe.

c. VTVM with high-voltage probe (20 kilovolts).

d. Detector probe for oscilloscope constructed as shown in Fig. 11.

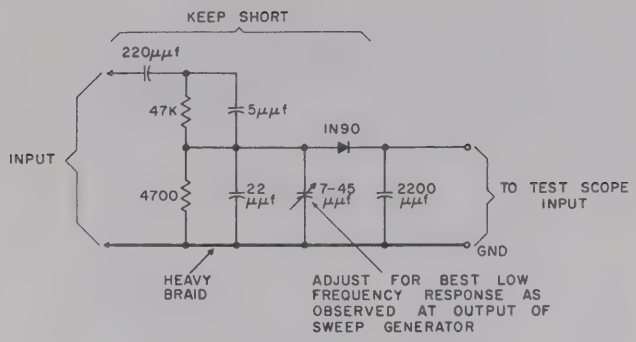


Fig. 11 Detector Probe

2. Picture Video Amplifier Frequency Reponse

a. Place TEST SIG switch S2 in the OFF position, CONTRAST control 1R7 at midrange, and HI-LO GAIN switch 1S1 in the position normally used for the Monitor's particular application.

b. Disconnect P102 from 1J2 and connect the sweep generator output to 1J2.

c. Place the oscilloscope detector probe on pin 3 of 1V4.

d. Adjust 1L2, 1L4, and 1L7 to give a flat response ± 1 db up to 10 megacycles.

e. Move the oscilloscope detector probe to 1P3 and remove the picture tube base plug.

f. Adjust 1L8 to give a flat response ± 1 db up to 10 mc.

3. Oscilloscope Video Amplifier Gain Adjustment.

a. High Gain

1) Place the WIDE BAND-IRE-CAL switch, 2S1, in the IRE position, the GAIN control, 2R6, in its maximum CW position and the HI-LO switch, 2S2, in the HI position.

2) With an input composite signal of 0.2 volt peak-to-peak, there should be at least three inches of deflection as observed on the graticule scale.

b. Low Gain

1) Place the HI-LO switch, 2S2, in the LO position.

2) With a 1.25 volt noncomposite input signal, it should be possible to set the GAIN control, 2R6, so that the waveform display fills the area between 0-100 as indicated on the graduated scale.

c. Calibrate

1) Place the WIDE BAND-IRE-CAL switch, 2S1, in the IRE position and set the SYNC SELECT switch, S3, in the NON COMP position. Apply a VIDEO IN signal to the Monitor from an accurately calibrated one volt signal source.

2) Adjust the GAIN control, 2R6, and the V CENT control, 2R4, so the external calibrated signal just fills the area between 0-100 on the graduated scale.

3) Plug the TX-15-A Meter into the METER JACK, 2J1, and place the WIDE BAND-IRE-CAL switch, 2S1, in the CAL position.

4) Adjust the CALIB ADJ control, 2R48, for a reading of 1.00 on the 0 to 3 volt scale of the TX-15-A Meter.

5) Remove the Meter from the circuit and observe the clipped sync signal. The sync signal amplitude must not deviate by more than ± 5% from that measured in step 2.

6) With a composite input signal of one volt video and $\frac{1}{4}$ to $\frac{1}{2}$ volt sync, place the SYNC SELECT switch, S3, in the COMP position and observe the clipped sync signal. This signal should be of the same amplitude as the signal in step 5.

4. Oscilloscope Frequency Response Alignment

a. Set the WIDE BAND-IRE-CAL switch (2S1) to the WIDE BAND position.

b. Remove tubes 2V2, 2V3, and 2V4.

c. Connect the sweep generator output to the positive side of 2C1, or the termination point of 2L on switch 2S1.

d. Connect the oscilloscope, using the low capacity probe shown in Fig. 11, to the termination point (2V2-E1) of 2C6, 2R16, and 2R17.

e. Set the CONTRAST control to its mid-position.

f. Observe the frequency response, checking to insure that it is at least 5 megacycles. It should be noted that the response can be down 2 db at 5 megacycles.

g. Reset the WIDE BAND-IRE-CAL switch to IRE.

h. Adjust coil 2L3 and capacitor 2C4 to produce an IRE frequency response of one

megacycle (78 percent) and 3.58 megacycles (10 percent).

i. Reset the WIDE BAND-IRE-CAL switch to WIDE BAND.

j. Reconnect the oscilloscope probe to the termination point (2V3-E2) of 2C10, 2R27, and 2R28.

k. Replace tube 2V2 and set the GAIN switch to HI.

l. Adjust coil 2L6 to allow a gradual taper of the signal to beyond 5 megacycles.

m. Remove the oscilloscope probe and observe the sweep display on the Master Monitor oscilloscope screen.

n. Replace tubes 2V3 and 2V4.

o. Adjust coils 2L7 and 2L8 to produce a flat response to 5 megacycles ± 1 db.

p. The frequency response to 3.58 megacycles must be flat (less than 1 db of variation).

5. Picture Automatic Frequency Control (AFC)

a. Place SYNC SELECT switch S3 in the NON COMP position.

b. Connect the trigger input of the test 'scope to external sync.

c. Connect the high impedance 'scope probe to 4P1-15 and adjust the 'scope sweep speed to display 5 to 15 horizontal pulses.

d. Transfer the 'scope probe to test point B (4J3) and connect the VTVM to test point A (4J2).

e. Ground the junction of 4C2, 4C4, and 4R5 (E11-9) to remove sync from the AFC input.

f. Withdraw the tuning slug of 4L1 and make sure that the sawtooth voltage at test point B is not synchronized with the horizontal sync trigger input of the test 'scope.

g. Adjust AFC BAL control 4R29 for -3.4 volts at test point A, making sure that the sawtooth at test point B remains unsynchronized.

h. Disconnect the ground connection made in step e and turn in oscillator coil 4L1 so that the AFC sawtooth is locked to the incoming sync as observed at test point B.

i. With the AFC locked up, continue turning 4L1 until test point A again reads -3.4 volts.

j. Adjust 4C10 for minimum kink at the top of the picture.

6. Picture Sweep Linearity

a. Center an 8 x 10 inch EIA linearity chart transparency in front of the picture tube.

b. Turn SYNC SELECT switch S3 to the NON COMP position.

c. Connect a grating signal into the TEST SIG (J8) input.

d. Turn TEST SIG switch S2 to ON.

e. Adjust HEIGHT (R5), V CENT (R4), H CENT (R2) and the deflection yoke rotation so that the grating intersections correspond with the circles on the linearity chart.

f. Adjust LEFT LIN (4R53) and RIGHT LIN (4R65) to improve horizontal linearity.

7. High Voltage

a. Turn BRIGHTNESS control R15 clockwise to obtain a fairly bright picture (about 20 to 40 foot-candles as measured with a photographic light meter placed flat against the picture tube window).

b. Connect the VTVM high-voltage probe to the picture tube anode connection.

c. Turn the tuning slug of 3L1 all the way out.

d. Set OUTPUT V adjust (3R12) to its midrange position and ground 3J2.

e. Turn in the tuning slug of 3L1 until maximum voltage is obtained.

f. Turn BRIGHTNESS control R15 counterclockwise until the picture tube is cut off. The output voltage should now be between 17 and 20 kilovolts.

g. Remove the ground connection from 3J2 and adjust 3R12 to obtain a +14 kilovolt output.

h. Turn BRIGHTNESS control R15 clockwise until a 50-foot-candle highlight picture is obtained as measured in step a. The high voltage should vary less than 100 volts.

After many thousand hours of operation, the voltage drop across neon lamps 3I1, 3I2, and 3I3 increases and will eventually cause poor regulation. When the drop across any one of the lamps exceeds 65 volts, it must be replaced.

PICTURE TUBE (14BAP4) REMOVAL

1. Remove the front panel by removing the three screws from each side and both pull-out handles.
2. Loosen the tube mounting straps on both sides.
3. Short the tube anode lead to ground.
4. Remove the anode lead and socket from the tube.
5. Loosen the yoke clamp.
6. Put on protective goggles and gloves and slide the tube straight out.

PICTURE TUBE (14BAP4) INSTALLATION

1. Loosen the picture tube mounting straps and position the anode lead so that it is accessible.
2. Raise the high-voltage chassis until it is locked in the open position.
3. Put on protective goggles and gloves, clean the tube, and place it in position with the anode connection on the right.
4. Place the yoke over the neck of the tube but do not tighten it.
5. Tighten the tube mounting straps just enough to hold the tube in place.

NOTE

If it is also necessary to install the oscilloscope tube, see Picture Tube Focusing, below, before replacing the Monitor front panel.

6. Install the front panel with the six screws and two pull-out handles.
7. Push the tube forward to compress the sealing gasket and alternately adjust the mounting strap screws to secure the tube and center the viewing area in the panel opening.
8. Snap in the anode lead and install the tube socket.
9. Turn on the power, orient the yoke, and secure it in position.

PICTURE TUBE (14BAP4) FOCUSING

The 14BAP4 picture tube has been designed for high resolution capabilities with optimum center to edge focus. The FOCUS control, R10, will normally be effective in the area beyond 600 lines of resolution. Therefore, because of manufacturing variations in picture tubes, a beam correction magnet has been included with this unit for use with tubes that have center to edge focus variations. When necessary, the beam correction magnet should be installed over the space between the picture tubes cathode and grid #1, and then rotated for the best center to edge focus.

OSCILLOSCOPE TUBE (5AMP1)

1. Remove the Monitor front panel.
2. With the neck contacts facing down, place the oscilloscope tube into the electromagnetic shield.
3. Connect the tube socket and neck leads.
4. Replace the front panel, slide the tube forward as far as possible and orient it for proper display.
5. Lock in the base clamp.

Removal of the oscilloscope tube is performed by reversing the above procedure.

WAVEFORM PICTURES

Waveform pictures and a-c voltage amplitudes are shown in Figs. 12 through 18. These will provide reference waveforms and voltages when servicing the equipment. The input used was a composite monoscope signal with the waveform displayed on a Type 524D Tektronix oscilloscope. It is suggested that a wideband oscilloscope, such as the Tektronix or a Type 150A Hewlett-Packard, be used for servicing.

SOCKET VOLTAGES

The socket voltage charts, below, show typical readings which can be used as reference to help isolate troubles that are not a direct result of tube failure. The readings were taken with a Hewlett-Packard VTVM. A 1.0 volt peak-to-peak composite video input signal was used and the readings taken in respect to chassis ground. Voltages marked with an asterisk (*) indicate that 4V7, pins 7 and 8, are insulated from ground.

Tube	Pins 1	2	3	4	5	6	7	8	9
PICTURE VIDEO AMPLIFIER SUBCHASSIS #1									
1V1	190	19	21	6.3 a-c	6.3 a-c	210	19	21	0
1V2	2.5	3.9	6.3 a-c	0	215	150	3.9	-	-
1V3	6.3	8.3	6.3 a-c	0	200	160	8.3	-	-
1V4	280	190	190	6.3 a-c	6.3 a-c	160	0	1	0
1V5	0.5	0.5	6.5	6.3 a-c	0	0	230	0	240
1V6	0	0	6.3 a-c	0	275	54	0	-	-
OSCILLOSCOPE VIDEO AMPLIFIER SUBCHASSIS #2									
2V1	190	22	24	6.3 a-c	6.3 a-c	170	22	24	0
2V2	14	12	14	6.3 a-c	6.3 a-c	0	160	150	14
2V3	46	45	46	6.3 a-c	6.3 a-c	0	225	170	46
2V4	46	45	46	6.3 a-c	6.3 a-c	0	225	170	46
REGULATED HIGH-VOLTAGE SUPPLY SUBCHASSIS #3									
3V1	100	0.3	0	6.3 a-c	6.3 a-c	155	-16	0	0
3V2	170	6.3 a-c	8	-70	-70	8	0	170	-
3V3	-	-	590	-	270	-	6.3 a-c	0	-
3V4	-	14 kv	-	-	14 kv	-	14 kv	-	-
3V5	Approximately -2 kv d-c								
3V6	1 v a-c	0	-	1 v a-c	0	1 v a-c	-	0	1 v a-c
PICTURE AFC AND HORIZONTAL SWEEP SUBCHASSIS #4									
4V1	240	0	2.6	6.3 a-c	6.3 a-c	270	-8	0	0
4V2	65	-1.6	0	6.3 a-c	6.3 a-c	275	-54	6	0
4V3	-5.5	0	6.3 a-c	0	185	165	-2.5	-	-
4V4	225	125	132	6.3 a-c	6.3 a-c	78	-27	0	0
4V5	275	190	195	6.3 a-c	6.3 a-c	42	-23	0	0
4V6	200	6.3 a-c	29	0.5	0.5	29	0	200	-
4V7	210	250	400	210	250	400	6.3 a-c*	6.3 a-c*	-
PICTURE VERTICAL SWEEP SUBCHASSIS #5									
5V1	56	-0.9	0	6.3 a-c	6.3 a-c	276	-18	0	0
5V2	276	-11	0	6.3 a-c	6.3 a-c	280	26	30	0
5V3	93	0	1.4	6.3 a-c	6.3 a-c	120	0	3	0
5V4	265	0	13	6.3 a-c	6.3 a-c	13	0	0	265

	E	B1	B2
5Q1	30	10	0.16

Tube	Pins 1	2	3	4	5	6	7	8	9
OSCILLOSCOPE SWEEP SUBCHASSIS #6									
6V1	280	36	42	6.3 a-c	6.3 a-c	276	22	42	0
6V2	278	10	12	6.3 a-c	6.3 a-c	280	-50	12	0
6V3	150	50	59	6.3 a-c	6.3 a-c	150	50	59	0
	E	B1	C	B2					
6Q1	42	0	-	10					
6Q2	42	42	0	-					
BIAS-CENTERING-RELAY SUBCHASSIS #7									
7V1	0	-150	0	-150	0	0	-150	-	-

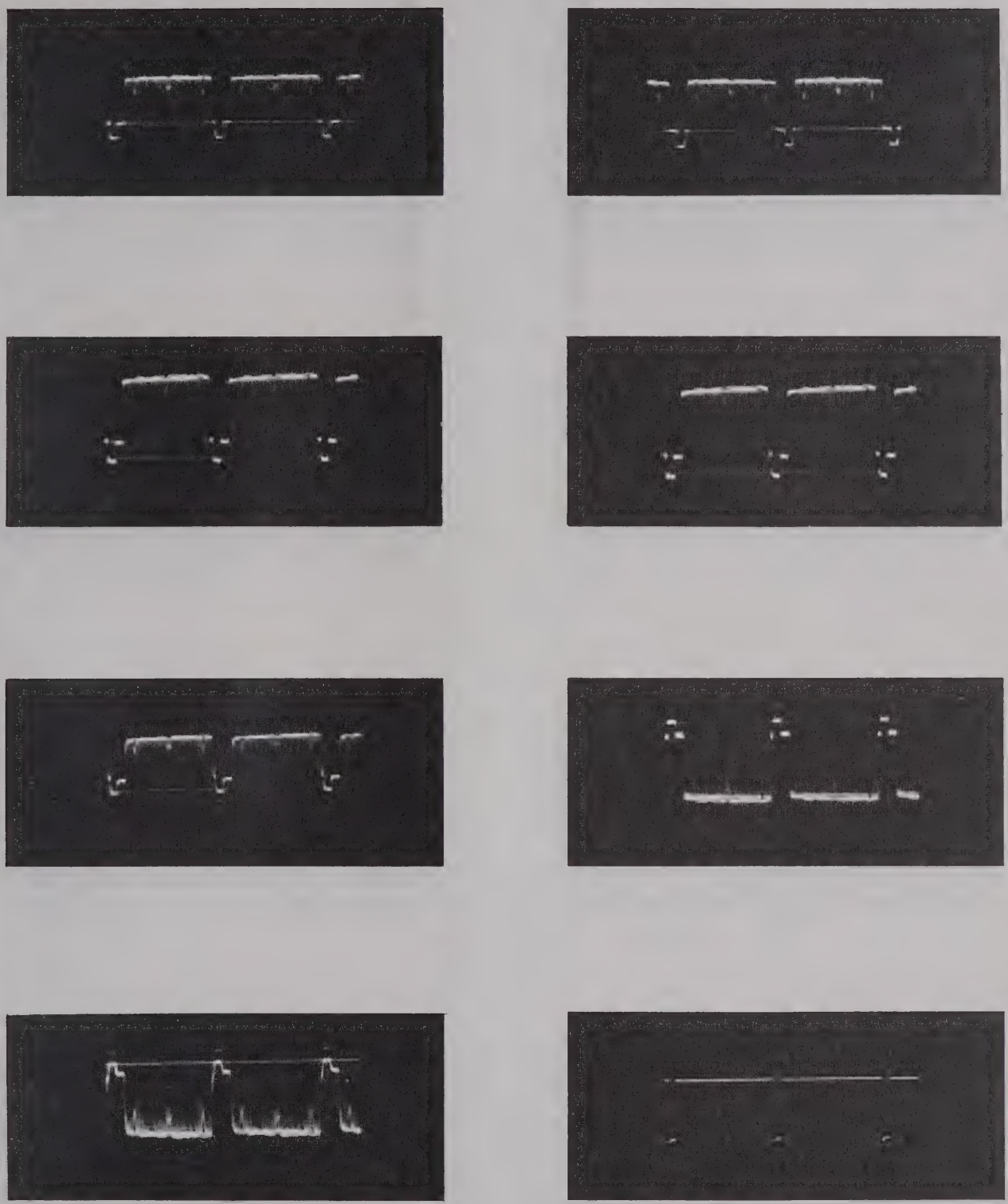
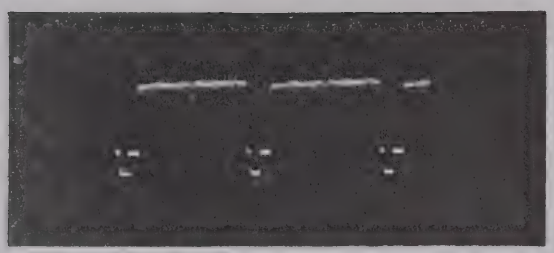
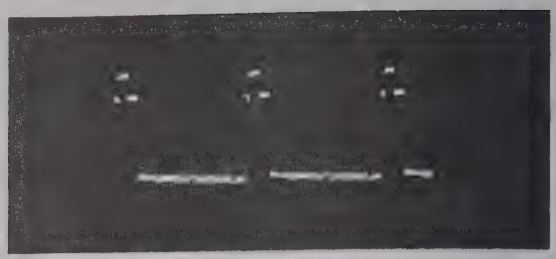


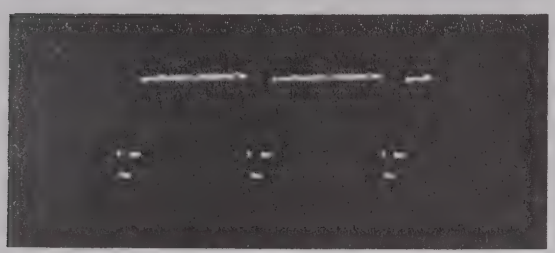
Fig. 12 Waveforms; 1V1, 1V2, 1V3, 1V4, 1V5, 1V6



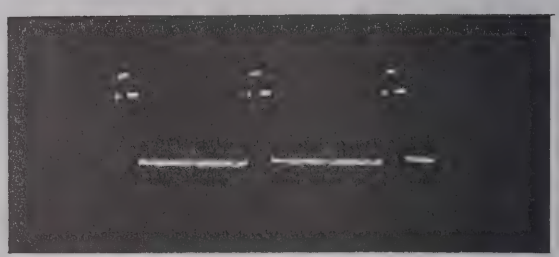
(a) 2V1, pin 1, 2S2 at LO GAIN, 2R6 at maximum, 4 volts P-P, V rate



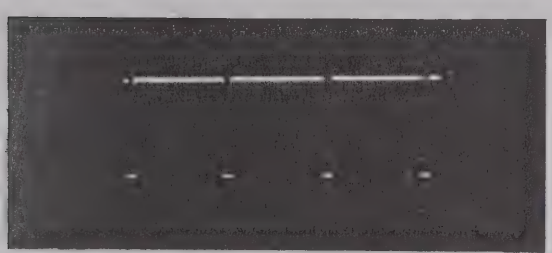
(b) 2V2, pin 7, 2S2 at LO GAIN, 2R6 at maximum, 10 volts P-P, V rate



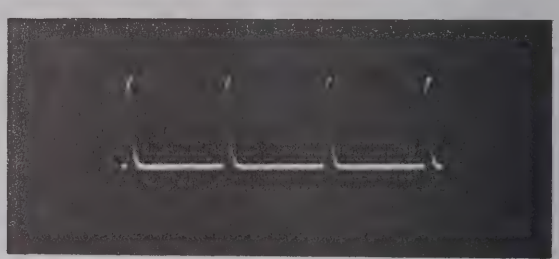
(c) 2V3, pin 7, 2S2 at LO GAIN, 2R6 at maximum, 100 volts P-P, V rate



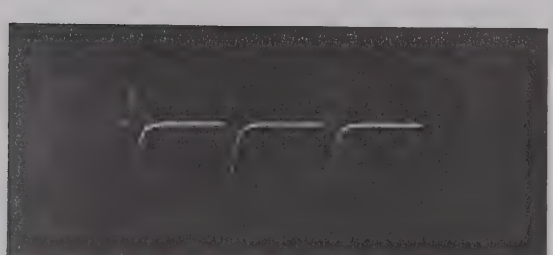
(d) 2V4, pin 7, 2S2 at LO GAIN, 2R6 at maximum, 95 volts P-P, V rate



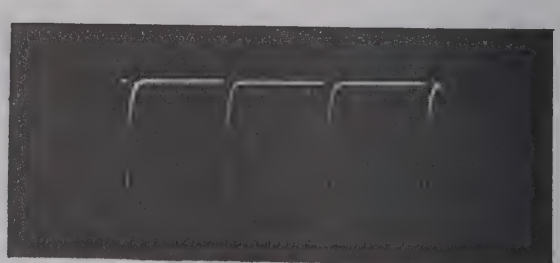
(e) 4V1, pin 2, 3.5 volts P-P, H rate



(f) 4V1, pin 1, 30 volts P-P, H rate

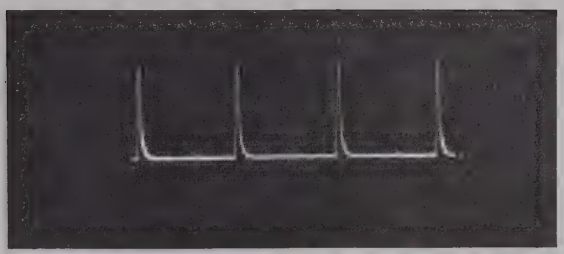


(g) 4V1, pin 7, 9 volts P-P, H rate

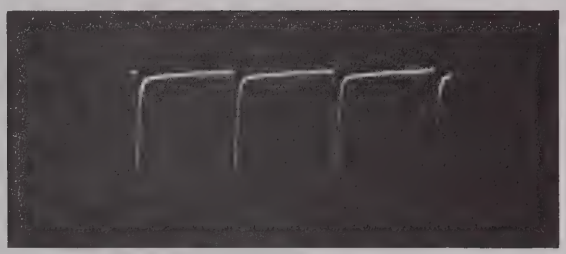


(h) 4V1, pin 6, 65 volts P-P, H rate

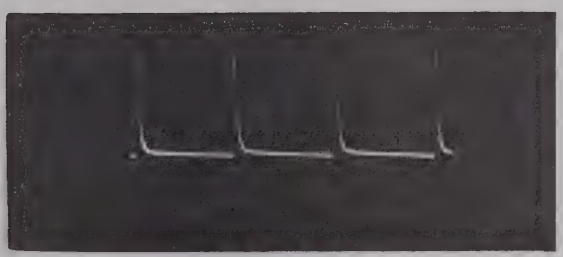
Fig. 13 Waveforms; 2V1, 2V2, 2V3, 2V4, 4V1



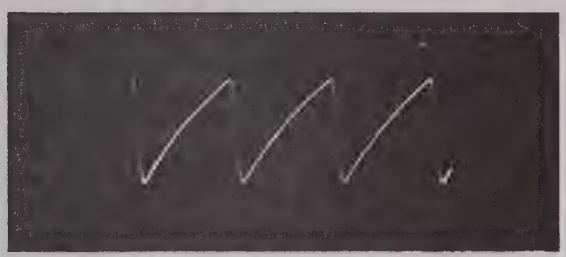
(a) 4V2, pin 1, 40 volts P-P, H rate



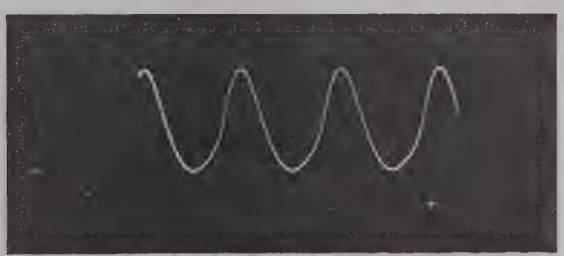
(b) 4V2, pin 6, 36 volts P-P, H rate



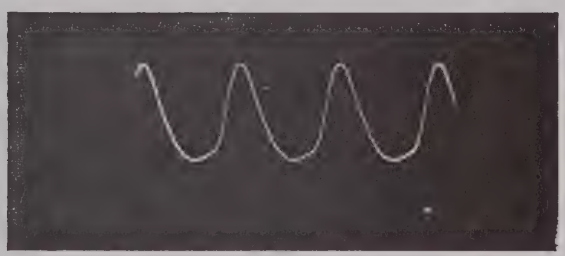
(c) 4V2, pin 8, 40 volts P-P, H rate



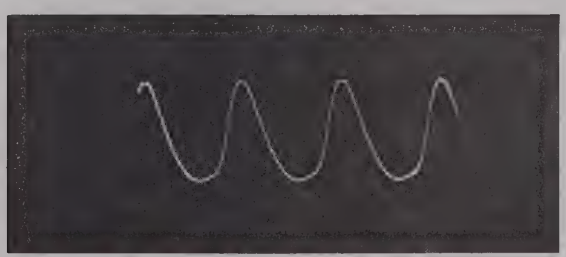
(d) 4J3, pin B, 40 volts P-P



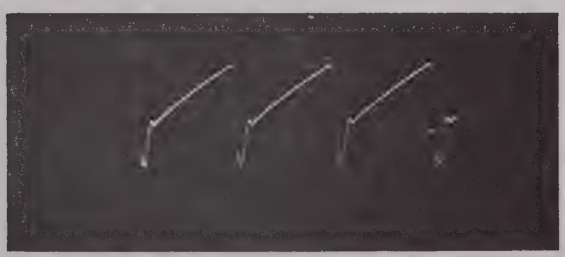
(e) 4V3, pin 5, 55 volts P-P, H rate



(f) 4V4, pin 3, 40 volts P-P, H rate

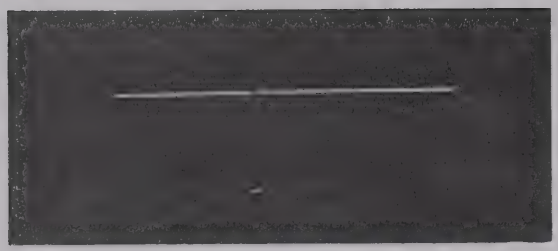


(g) 4V5, pin 7, 40 volts P-P, H rate

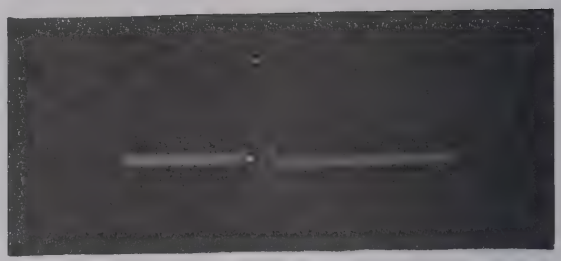


(h) 4V6, pins 4 and 5, 47 volts P-P, H rate

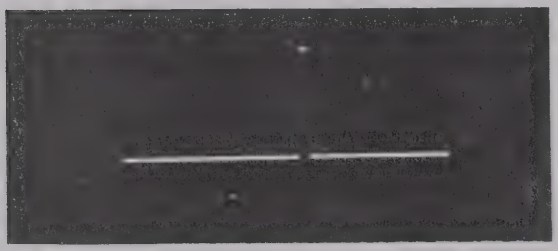
Fig. 14 Waveforms; 4V2, 4J3, 4V3, 4V4, 4V5, 4V6



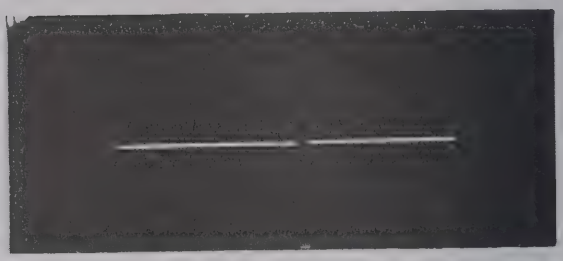
(a) 5V1, pin 2, 3.5 volts P-P, V rate



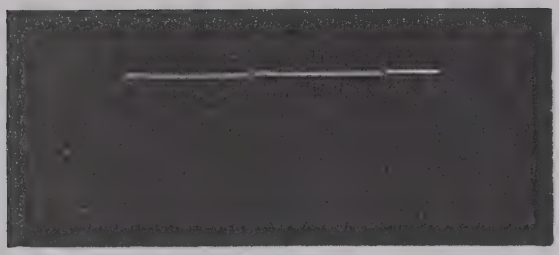
(b) 5V1, pin 7, 30 volts P-P, V rate



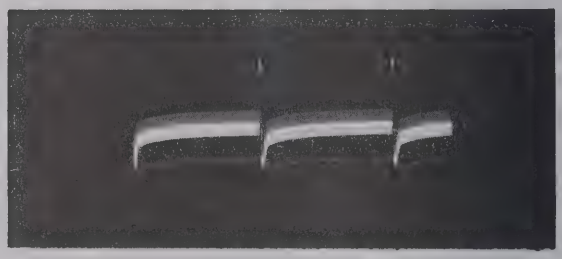
(c) 5V1, pin 1, 50 volts P-P, V rate



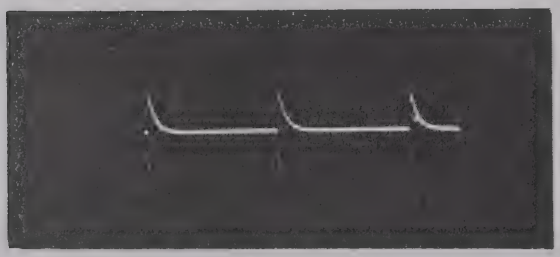
(d) 5V1, pin 6, 140 volts P-P, V rate



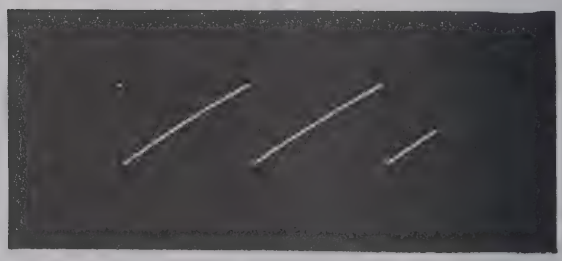
(e) 5V2, pin 1, 160 volts P-P, V rate



(f) 5V2, pin 2, 18 volts P-P, V rate

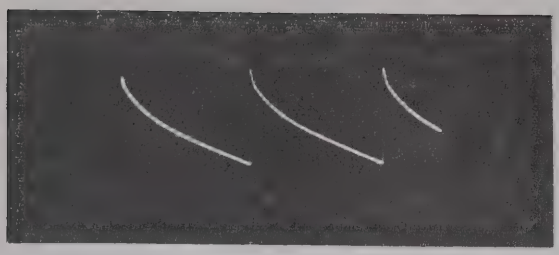


(g) 5V2, pin 8, 46 volts P-P, V rate

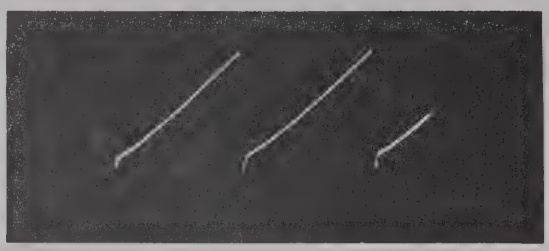


(h) 5Q1, pin E, 13 volts P-P, V rate

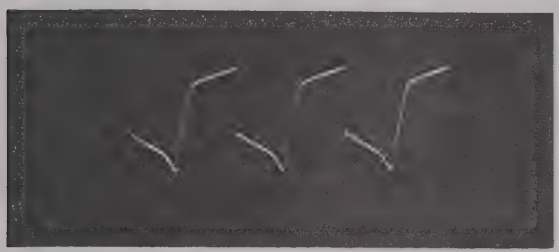
Fig. 15 Waveforms; 5V1, 5V2, 5Q1



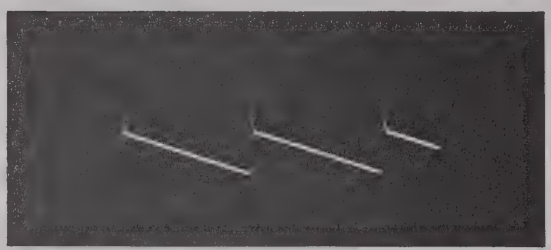
(a) 5V3, pin 1, 10 volts P-P, V rate



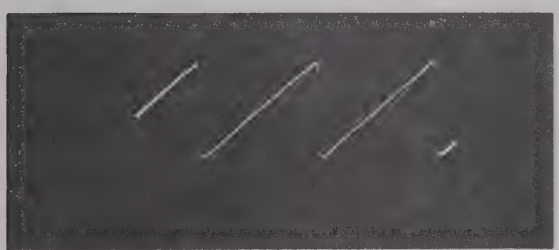
(b) 5V3, pin 6, 45 volts P-P, V rate



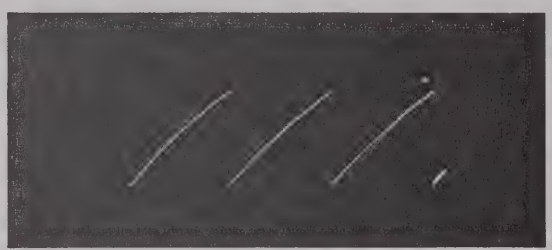
(c) 5V4, pin 2, 6S1 at PULSE CROSS, 65 volts P-P, V rate



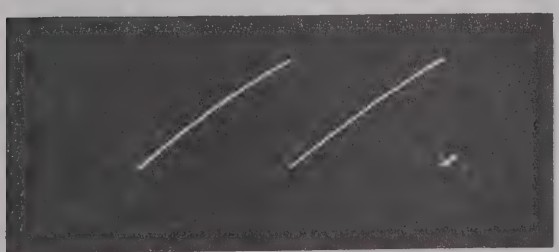
(d) 5V4, pins 1 and 9, 400 volts P-P, V rate



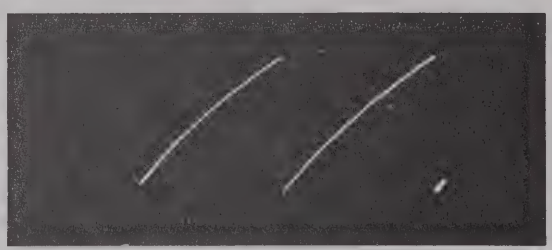
(e) 6V2, pin 3, 6S1 at HORIZONTAL, 20 volts P-P



(f) 6V2, pin 3, 6S1 at VERTICAL, 20 volts P-P

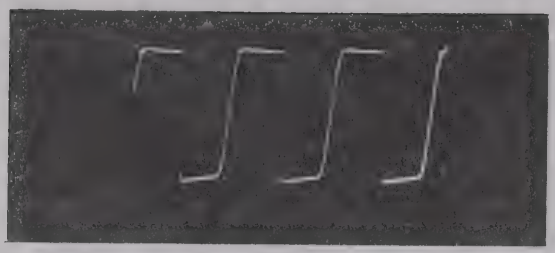


(g) 6V2, pin 3, Rate at 20 cps, 20 volts P-P

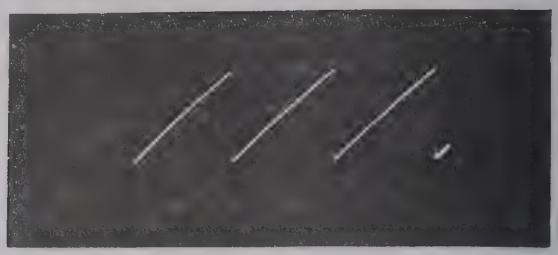


(h) 6Q2, pin B, Rate at 20 cps, 4.5 volts P-P

Fig. 16 Waveforms; 5V3, 5V4, 6V2, 6Q2

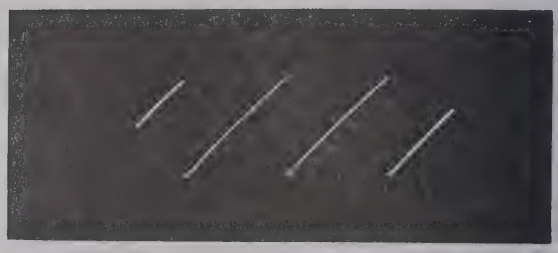


(a) 6V3, pin 2, 6S2 at EXPAND, 45 volts P-P, V rate

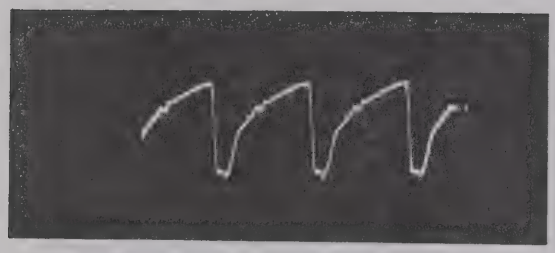


(b) 6V3, pin 2, 6S2 at NORMAL, 15 volts P-P, V rate

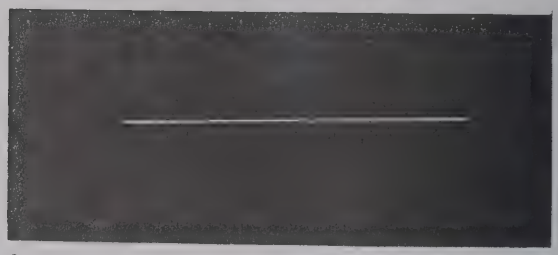
(c) 6V3, pin 6, 6S2 at EXPAND, 155 volts P-P, V rate



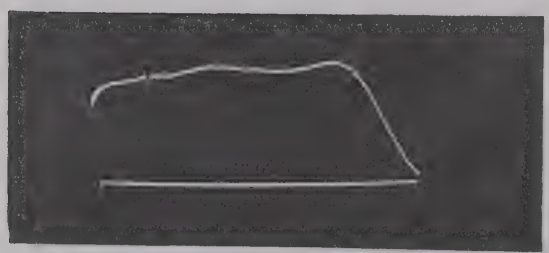
(d) 6V3, pin 6, 6S2 at NORMAL, 90 volts P-P, V rate



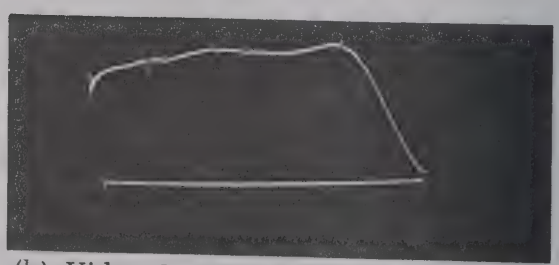
(e) 3V2, pins 4 and 5, 150 volts P-P, H rate



(f) Junction of 6C15 and 6C16, 5.5 volts P-P, V rate

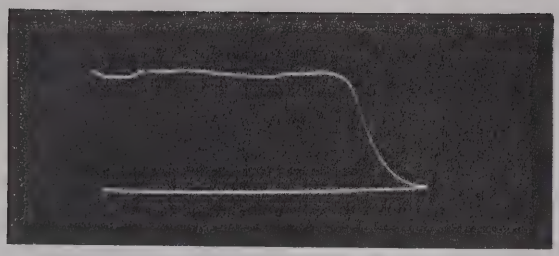


(g) Video Out Test Point 1P3, 1S1 at LO GAIN

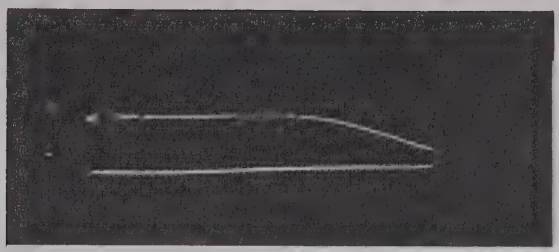


(h) Video Out Test Point 1P3, 1S1 at LO GAIN

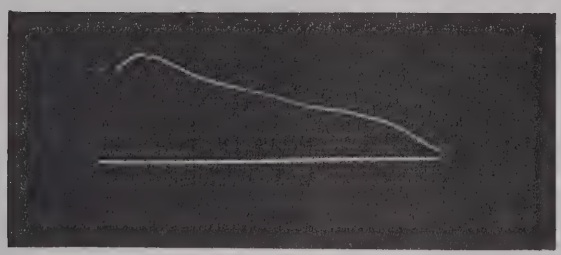
Fig. 17 Waveforms; 3V2, 6V3, 6C15 and 6C16, Video Out



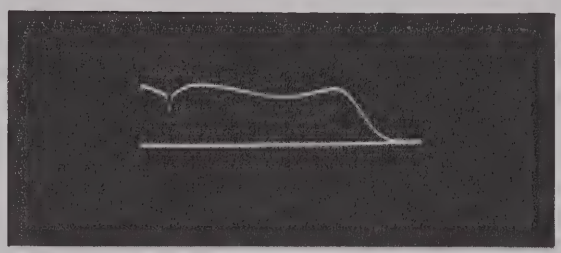
(a) Video Out Test Point 1P3, 1S1 at HI GAIN



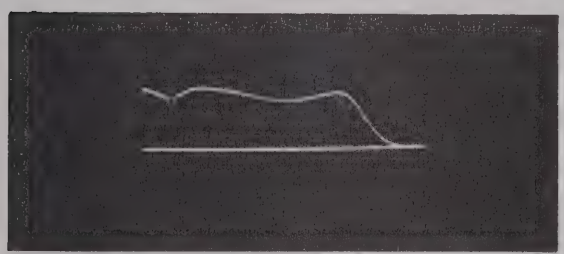
(b) 2V1, pins 1 and 6, 2S1 at WIDE BAND



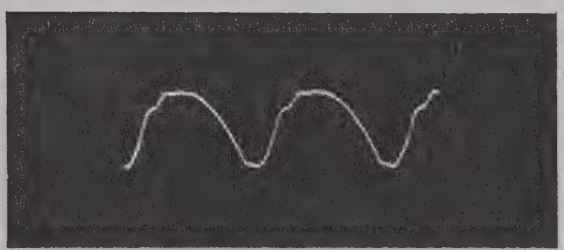
(c) 2V2, pin 7, 2S1 at WIDE BAND



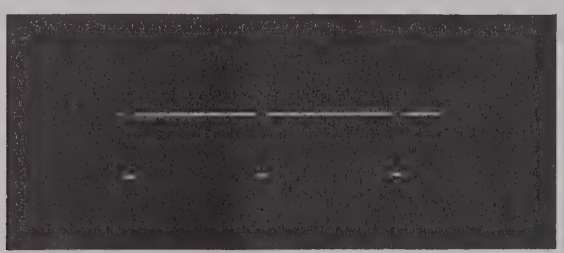
(d) 2V3, pin 7, 2S1 at WIDE BAND



(e) 2V4, pin 7, 2S1 at WIDE BAND



(f) 3R10, 25 volts P-P



(g) 2E14, 1 volt P-P

Fig. 18 Waveforms; Video Out, 2V1, 2V2, 2V3, 2V4, 3R10, 2E14

PARTS LIST

SYMBOL	DESCRIPTION	G-E DRAWING
	MONITOR MODEL 4TM21A1	
	CAPACITORS	
C1	Electrolytic, 35 mfd +100% -10%, 15 v d-c w. Sprague Cat. #30D169A1.	B-7489483-P10
C4	Paper, molded plastic, 0.1 mfd ± 20%, 200 v d-c w. Sprague Cat. #109P10402.	B-7491096-P13
C5	Paper, molded plastic, 0.47 mfd ± 20%, 200 v d-c w. Sprague Cat. #109P47402.	B-7491096-P17
	FUSES	
F1	Slow blow, Type 3AG, 1 amp at 250 v. Bussman Cat. #MDL-1.	B-7487942-P5
F2	Slow blow, Type 3AG, 2 amp at 125 v. Bussman Cat. #MDL-2.	B-7487942-P27
	INDICATING LAMPS.	
I1	G-E Cat. #51.	A-7164423-P7
I2	G-E Cat. #47.	A-7164423-P6
	JACKS AND RECEPTACLES	
J1	Receptacle, 15 pin male. HB Jones Cat. #P-315-AB.	P-7767680-P8
J2 thru J8	Receptacles. Amphenol Cat. #83-1R, Signal Corps #SO-239.	M-2R22-P3
J101	Socket. Cinch-Jones Cat. #S-321-AB with polarizing socket in #11 position.	A-7167435-P1
J103	Jack, banana type.	K-7868736-P3
J210	Socket. Cinch-Jones Cat. #S-321-AB with polarizing socket in #11 position.	A-7167435-P1
J203 and J204	Jacks, banana type.	K-7868736-P3
J401	Socket. Cinch-Jones Cat. #S-321-AB with polarizing socket in #11 position.	A-7167435-P1
J404 and J405	Jacks, banana type.	K-7868736-P3
J501 and J601	Socket. Cinch-Jones Cat. #S-321-AB with polarizing socket in #11 position.	A-7167435-P1
J602 thru J605	Jacks, banana type.	K-7868736-P3
J701	Socket. Cinch-Jones Cat. #S-321-AB with polarizing socket in #11 position.	A-7167435-P1
	RELAY	
K1	Pickup 5.0 ma or less, coil rated 10 ma continuous, resistance 10,000 ohms ± 10%, twin 2 form C contacts. Automatic Elec. Type SQA.	M-7485625-P6
	INDUCTOR	
L1	Deflection yoke assembly. FW Sickles Cat. #174J62-2SP.1.	B-7493461-P1
	PLUGS	
P1	15 female contacts. HB Jones Cat. #S-315-CCT.	P-7767680-P43
P2 thru P8	2 piece straight plugs. Amphenol Cat. #83-1SP, Signal Corps #PL-259.	M-2R22-P1
P102	Long pin. Cinch Cat. #15H20309.	K-7104941-P8
P301	Receptacle, 8 female contacts. Cinch-Jones Cat. #S308-FHE.	B-7493837-P14
P303	Alden Products Co. Cat. #8101M.	A-7167289-P2

SYMBOL	DESCRIPTION	G-E DRAWING
	RESISTORS (Composition, ± 5%, ½ w, unless otherwise specified)	
R1	Potentiometer, composition, 100,000 ohms ± 20%, 2.25 w, linear taper. Allen Bradley Type J.	M-2R73-P20
R2	Potentiometer, wirewound, 500 ohms ± 10%, 2 w, linear taper. Chicago Telephone Type 252.	M-2R72-P17
R3	Potentiometer, composition, 1.0 megohm ± 20%, 2.25 w, linear taper. Allen Bradley Type J.	M-2R73-P26
R4	Potentiometer, wirewound, dual, 20 ohms ± 10% each section, 2 w, mod log taper. IRC Type W-20.	P-7768983-P16
R5	Potentiometer, composition, 1.0 megohm ± 20%, 2.25 w, linear taper. Allen Bradley Type J.	M-2R73-P26
R6	0.10 megohm.	C-3R77-P104J
R7	Plate cap assembly. Includes composition resistor, G-E Drawing C-3R78-P100J, rated 10 ohms ± 5%, 1 w. Cap assembly Alden Part #91ICCSRL.	C-7777122-P6
R8	Wirewound, 50 ohms ± 5%, 10 w. Sprague Type 10KT with tab terminals and Style C mtg.	M-7478633-P78
R10	Potentiometer, composition, 2.0 megohm ± 20%, 2.25 w, linear taper. Allen Bradley Type J.	M-2R73-P28
R11	75 ohms.	C-3R77-P750J
R12	1000 ohms.	C-3R77-P102J
R13	100 ohms.	C-3R77-P101J
R14	75 ohms.	C-3R77-P750J
R15	Potentiometer, composition, 100,000 ohms ± 20%, 2.25 w, linear taper. Allen Bradley Type J.	M-2R73-P20
R16	56,000 ohms.	C-3R77-P563J
R17	0.10 megohm.	C-3R77-P104J
R21 and R22	12,000 ohms, 2 w.	C-3R79-P123J
R23 and R24	0.47 megohm.	C-3R77-P474J
R25	75 ohms.	C-3R77-P750J
	SWITCHES	
S1	Dpst, 6 amp at 250 v, 12 amp at 125 v. Arrow Hart and Hegeman Cat. #80600-D with bat handle.	K-7109677-P1
S2	Rotary style, spdt, shorting type contacts. Oak Type 23.	B-7488282-P3
S3	Rotary style, miniature, 1 section, 3 pole, 3 position, shorting type contacts. Centralab series 100, Oak Type A.	C-5494644-P7
	TRANSFORMERS	
T1	Filament and rectifier, single phase. Pri: 110/117/125 v, 50/60 cycles; sec #1: 110 v, 0.06 amp; sec #2: 6.3 v, 8.0 amp; sec #3: 6.3 v, 2.5 amp; sec #4: 6.3 v, 0.6 amp.	B-7493825-P1
T3	Transformer assembly.	A-7167901-G1
	FUSE HOLDERS	
XF1 and XF2	Bussman Type HKP.	K-7115179-P1
	INDICATOR LIGHT SOCKETS	
XI1	Miniature bayonet base type.	B-7495341-P1
XI2	Miniature bayonet base. EF Johnson Cat. #147-610, bracket down.	B-7487665-P1

SYMBOL	DESCRIPTION	G-E DRAWING
	PICTURE VIDEO AMPLIFIER SUBCHASSIS PL-7670815G1	
	CAPACITORS (Paper, molded plastic, ± 20%, 400 v d-c w, unless otherwise specified)	
1C1	Mylar, dielectric, 1.0 mfd ± 20%, 100 v d-c w. G-E Type 61F.	B-7491930-P13
1C2	Electrolytic, 10 mfd +100% -10%, 25 v d-c w. Sprague Cat. #30D182A1.	B-7489483-P7
1C3	Electrolytic, polarized twist prong base, 20-20-20 mfd +100% -10%, 350-350-350 v d-c w.	C-7776308-P34
1C5	Mylar, dielectric, 0.22 mfd ± 10%, 400 v d-c w. Good-All Type 663-UW.	C-7777865-P360
1C6	Electrolytic, polarized twist prong base, 20-20-20 mfd +100% -10%, 350-350-350 v d-c w.	C-7776308-P34
1C7	Mylar, dielectric, 0.47 mfd ± 20%, 400 v d-c w. Good-All Type 663-UW.	C-7777865-P312
1C8	0.33 mfd. Sprague Cat. #109P33304.	B-7491096-P30
1C9	Silver mica, 100 mmfd ± 5%, 500 v d-c w. Electromotive Mfg. Co. Type DM15.	B-7489162-P27
1C10	Electrolytic, polarized twist prong base, 20-20-20 mfd +100% -10%, 350-350-350 v d-c w.	C-7776308-P34
1C11	0.1 mfd. Sprague Cat. #160P10404.	C-7778840-P33
1C12 and 1C13	Mylar, dielectric, 0.22 mfd ± 10%, 400 v d-c w. Good-All Type 663-UW.	C-7777865-P360
1C14	Electrolytic, polarized twist prong base, 20-20-20 mfd +100% -10%, 350-350-350 v d-c w.	C-7776308-P34
1C15 thru 1C17	0.1 mfd. Sprague Cat. #160P10404.	C-7778840-P33
1C18	Silver mica, 100 mmfd ± 5%, 500 v d-c w. Electromotive Mfg. Co. Type DM15.	B-7489162-P27
	RECTIFIERS	
1CR1	Silicon diode. Hughes Type 1N629.	C-5494923-P5
1CR2	Germanium diode. Hughes Type 1N90.	C-7777146-P3
	JACK	
1J2	Phono type. Cinch Cat. #14H18331.	K-7104941-P5
	INDUCTORS	
1L1	RF choke, inductance 5.6 uh ± 10%, 0.15 ohm max d-c resistance. Jeffers Cat. #10203-20.	B-7488079-P40
1L2	Variable, inductance 9 to 18 uh, 1.21 ohms approx d-c resistance. North Hills Type PF120D.	B-7491855-P6
1L3	RF choke, inductance 18.0 uh ± 10%, 0.8 ohm max d-c resistance. Jeffers Cat. #10203-32.	B-7488079-P46
1L4	Variable, inductance 18 to 36 uh, 1.72 ohms approx d-c resistance. North Hills Type PF120E.	B-7491855-P7
1L5	RF choke, inductance 3.3 uh ± 10%, 0.15 ohm max d-c resistance. Jeffers Cat. #10102-20.	B-7488079-P10
1L6	RF choke, inductance 18.0 uh ± 10%, 0.8 ohm max d-c resistance. Jeffers Cat. #10203-32.	B-7488079-P46
1L7	Variable, inductance 36 to 64 uh, 2.0 ohms approx d-c resistance. North Hills Type PF120F.	B-7491855-P8
1L8	Variable, inductance 18 to 36 uh, 1.72 ohms approx d-c resistance. North Hills Type PF120E.	B-7491855-P7
1L9	RF choke, 27.0 uh ± 10%, 0.36 ohm max d-c resistance. Jeffers Cat. #10404-22.	B-7488079-P66
	PLUGS	
1P1	Cinch-Jones Cat. #P-321-AB with polarizing pin in #11 position.	A-7167435-P2
1P3	Banana type.	K-7868735-P2

SYMBOL	DESCRIPTION	G-E DRAWING
	RESISTORS (Composition, ± 5%, ½ w, unless otherwise specified)	
1R1	100 ohms.	C-3R77-P101J
1R2	1.0 megohm.	C-3R77-P105J
1R3	6800 ohms.	C-3R77-P682J
1R4	0.10 megohm, 2 w.	C-3R79-P104J
1R5	10,000 ohms, 2 w.	C-3R79-P103J
1R6	2200 ohms.	C-3R77-P222J
1R7	Potentiometer, composition, with switch, 1000 ohms ± 20%, 2.25 w, linear taper. Allen Bradley Type J.	B-7493828-P8
1R8	0.10 megohm.	C-3R77-P104J
1R9 and 1R10	1.0 megohm.	C-3R77-P105J
1R11	2200 ohms.	C-3R77-P222J
1R12	100 ohms.	C-3R77-P101J
1R13	5100 ohms.	C-3R77-P512J
1R15	1000 ohms.	C-3R77-P102J
1R16	6800 ohms, 2 w.	C-3R79-P682J
1R18	240 ohms.	C-3R77-P241J
1R19	150 ohms.	C-3R77-P151J
1R20	0.10 megohm.	C-3R77-P104J
1R21	100 ohms.	C-3R77-P101J
1R22	5100 ohms.	C-3R77-P512J
1R23	560 ohms.	C-3R77-P561J
1R24	1000 ohms.	C-3R77-P102J
1R25	10,000 ohms, 2 w.	C-3R79-P103J
1R26	47,000 ohms, 1 w.	C-3R78-P473J
1R27 and 1R28	5.1 megohm.	C-3R77-P515J
1R29	510 ohms.	C-3R77-P511J
1R30	160 ohms.	C-3R77-P161J
1R31	1.0 megohm.	C-3R77-P105J
1R32	0.10 megohm.	C-3R77-P104J
1R33	3600 ohms, 2 w.	C-3R79-P362J
1R34	100 ohms.	C-3R77-P101J
1R35	6800 ohms.	C-3R77-P682J
1R36	1000 ohms.	C-3R77-P102J
1R37	2000 ohms.	C-3R77-P202J
1R38	6800 ohms, 2 w.	C-3R79-P682J
1R39	51,000 ohms, 1 w.	C-3R78-P513J
1R40	6800 ohms, 2 w.	C-3R79-P682J
1R41	100 ohms.	C-3R77-P101J
1R42	6800 ohms, 2 w.	C-3R79-P682J
1R43	0.47 megohm.	C-3R77-P474J
1R44	130 ohms, 1 w.	C-3R78-P131J
1R45	100 ohms.	C-3R77-P101J
1R46	5100 ohms.	C-3R77-P512J
1R47	7500 ohms.	C-3R77-P752J
1R48 and 1R49	3600 ohms, 2 w.	C-3R79-P362J
1R50	9100 ohms, 2 w.	C-3R79-P912J

SYMBOL	DESCRIPTION	G-E DRAWING
	RESISTORS (CONTINUED) (Composition, ± 5%, ½ w, unless otherwise specified)	
1R51	62,000 ohms, 2 w.	C-3R79-P623J
1R52 and 1R53	10.0 megohm.	C-3R77-P106J
1R54	Potentiometer, composition, 10,000 ohms ± 20%, 2.25 w, linear taper. Allen Bradley Type J.	M-2R73-P14
1R55	1.0 megohm.	C-3R77-P105J
1R56	100 ohms.	C-3R77-P101J
1R57	10,000 ohms, 1 w.	C-3R78-P103J
1R58	100 ohms.	C-3R77-P101J
1R59	10.0 megohm.	C-3R77-P106J
1R60	470 ohms.	C-3R77-P471J
1R61	0.10 megohm, 1 w.	C-3R78-P104J
1R62	27,000 ohms.	C-3R77-P273J
	SWITCH	
1S1	Slide switch, dpst, nonshorting silver plated brass contacts. Oak Type 76.	B-7493820-P2
	TUBE SOCKETS (Mica filled molded plastic, 4 ground lugs)	
1XV1	9 pin miniature. Elco Code #91662, #BRTL989PHSPTD.	B-7494154-P3
1XV2 and 1XV3	7 pin miniature. Elco Code #91662, #BRTL987PHSPTD.	B-7494154-P1
1XV4 and 1XV5	9 pin miniature. Elco Code #91662, #BRTL989PHSPTD.	B-7494154-P3
1XV6	7 pin miniature. Elco Code #91662, #BRTL987PHSPTD.	B-7494154-P1
	OSCILLOSCOPE VIDEO AMPLIFIER SUBCHASSIS PL-7670814G1	
	CAPACITORS (Electrolytic, polarized twist prong base, +100% -10%, unless otherwise specified)	
2C1	Mylar, metallized, 2.0 mfd ± 10%, 100 v d-c w. Good-All Type X663F.	B-7493817-P3
2C2	20-20-20 mfd, 350-350-350 v d-c w.	C-7776308-P33
2C3	Electrolytic, 10 mfd +100% -10%, 25 v d-c w. Sprague Cat. #30D182A1.	B-7489483-P7
2C4	Ceramic, variable, 7 to 45 mmfd, 500 v d-c w. Erie Style 503.	M-7484389-P6
2C5	Silver mica, 180 mmfd ± 5%, 500 v d-c w. Electromotive Mfg. Co. Type DM15.	B-7489162-P33
2C6	Mylar, metallized, 1.0 mfd ± 10%, 400 v d-c w. Good-All Type X663F.	B-7493817-P1
2C10	Mylar, dielectric, 0.22 mfd ± 10%, 400 v d-c w. Good-All Type 663-UW.	C-7777865-P360
2C12	20-20-20 mfd, 350-350-350 v d-c w.	C-7776308-P33
2C13	Mylar, dielectric, 1.0 mfd ± 20%, 100 v d-c w. G-E Type 61F.	B-7491930-P13
2C14	20-20-20 mfd, 350-350-350 v d-c w.	C-7776308-P33
2C16 and 2C17	Mylar, dielectric, 0.15 mfd ± 10%, 400 v d-c w. Good-All Type 663-UW.	C-7777865-P367
2C18	Silver mica, 2200 mmfd ± 5%, 500 v d-c w. Electromotive Mfg. Co. Type DM20.	A-7147203-P16
2C19	Paper, molded plastic, 0.01 mfd ± 20%, 400 v d-c w. Sprague Cat. #109P10304.	B-7491096-P27
2C20	Paper, molded plastic, 0.1 mfd ± 20%, 400 v d-c w. Sprague Cat. #160P10404.	C-7778840-P33
2C21	Silver mica, 33 mmfd ± 5%, 500 v d-c w. Electromotive Mfg. Co. Type DM15.	B-7489162-P15

SYMBOL	DESCRIPTION	G-E DRAWING
	CAPACITORS (CONTINUED) (Electrolytic, polarized twist prong base, +100% -10%, unless otherwise specified)	
2C22	Mylar, dielectric, 0.1 mfd ± 20%, 50 v d-c w. Good-All Type 601PE.	B-5491189-P6
	RECTIFIERS	
2CR1 and 2CR2	Germanium diodes. Hughes Type HD2151.	B-7496693-P2
2CR3 and 2CR4	Silicon diodes. Hughes Type 1N629.	C-5494923-P5
	JACK	
2J2	Telephone type. Switchcraft Inc. Cat. #XA-8255.	A-7167904-P1
2J3	Test point jack, nylon. EF Johnson Cat. #105-602-1, Red.	A-7143959-P2
	INDUCTORS	
2L1	RF choke, 12.0 uh ± 10%, 1.0 ohm max d-c resistance. Jeffers Cat. #10102-34.	B-7488079-P17
2L3	Coil, variable, 105 to 200 uh, 5.95 ohms approx d-c resistance. North Hills Type #PF120H.	B-7491855-P10
2L4	RF choke, 3.3 uh ± 10%, 0.15 ohm max d-c resistance. Jeffers Cat. #10102-20.	B-7488079-P10
2L6	Coil, variable, 18 to 36 uh, 1.72 ohms approx d-c resistance. North Hills Type #PF120E.	B-7491855-P7
2L7 and 2L8	Coils, variable, 36 to 64 uh, 2.0 ohms approx d-c resistance. North Hills Type #PF120F.	B-7491855-P8
2L9 and 2L10	RF chokes, 56 uh ± 10%, 1.3 ohms max d-c resistance. Jeffers Cat. #10404-30.	B-7488079-P70
2L11 and 2L12	RF chokes, 100 uh ± 10 %, 2.8 ohms max d-c resistance. Jeffers Cat. #10404-34.	B-7488079-P72
	PLUGS	
2P1	Cinch-Jones Cat. #P-321-AB with polarizing pin in #11 position.	A-7167435-P2
2P3 and 2P4	Banana type.	K-7868735-P2
	RESISTORS (Composition, ± 5%, ½ w, unless otherwise specified)	
2R1	100 ohms.	C-3R77-P101J
2R2	1.0 megohm.	C-3R77-P105J
2R3	75,000 ohms, 2 w.	C-3R79-P753J
2R4	6800 ohms.	C-3R77-P682J
2R5	2200 ohms.	C-3R77-P222J
2R6	Potentiometer, carbon film, 1000 ohms ± 20%, 0.3 w, linear taper. Chicago Telephone Type 70.	C-5494774-P2
2R7	10,000 ohms, 2 w.	C-3R79-P103J
2R8	2200 ohms.	C-3R77-P222J
2R9	1.0 megohm.	C-3R77-P105J
2R10	100 ohms.	C-3R77-P101J
2R14	6800 ohms, 2 w.	C-3R79-P682J
2R16	100 ohms.	C-3R77-P101J
2R17	0.47 megohm.	C-3R77-P474J
2R18	56 ohms.	C-3R77-P560J
2R19	330 ohms.	C-3R77-P331J
2R21	16,000 ohms, 2 w.	C-3R79-P163J
2R23	3900 ohms, 2 w.	C-3R79-P392J

SYMBOL	DESCRIPTION	G-E DRAWING
	RESISTORS (CONTINUED) (Composition, ± 5%, ½ w, unless otherwise specified)	
2R24	1500 ohms, 2 w.	C-3R79-P152J
2R25	4300 ohms, 2 w.	C-3R79-P432J
2R26	20,000 ohms.	C-3R77-P203J
2R27	100 ohms.	C3R77-P101J
2R28	0.47 megohm.	C-3R77-P474J
2R29	0.10 megohm, 1 w.	C-3R78-P104J
2R30	Wirewound, 630 ohms ± 5%, 5 w. Sprague Type 5KT with tab terminals and Style C mtg.	M-7478632-P89
2R31	0.47 megohm.	C-3R77-P474J
2R32	100 ohms.	C-3R77-P101J
2R33 and 2R34	3000 ohms, 2 w.	C-3R79-P302J
2R35	10,000 ohms.	C-3R77-P103J
2R36	3000 ohms, 2 w.	C-3R79-P302J
2R37	10,000 ohms.	C-3R77-P103J
2R38	8200 ohms, 2 w.	C-3R79-P822J
2R39 and 2R40	10.0 megohm.	C-3R77-P106J
2R41	Potentiometer, composition,dual, each section rated 100,000 ohms ± 20%, 2 w, linear taper. Allen Bradley Spec. #JD1N056P104M.	P-7768919-P21
2R42	47,000 ohms, 1 w.	C-3R78-P473J
2R43	47,000 ohms, 1 w.	C-3R78-P473J
2R44	Potentiometer, composition, dual, each section rated 1.0 megohm ± 20%, 2 w, linear taper. Allen Bradley Spec. #27771.	P-7768919-P8
2R45	Potentiometer, carbon film, 500,000 ohms ± 20%, 0.2 w, linear taper. Chicago Telephone Type 70 Control.	C-5494774-P9
2R46	1.2 megohm.	C-3R77-P125J
2R47	47,000 ohms, 2 w.	C-3R79-P473J
2R48	Potentiometer, carbon film, 5,000 ohms ± 20%, 0.3 w, linear taper. Chicago Telephone Type 70 Control.	C-5494774-P3
2R49	8200 ohms.	C-3R77-P822J
2R50	100 ohms.	C-3R77-P101J
2R51	27,000 ohms.	C-3R77-P273J
2R52	Deposited carbon on ceramic, 2900 ohms ± 1%, ½ w. IRC Type DCC.	C-7774319-P162
2R53 and 2R54	10,000 ohms.	C-3R77-P103J
2R55	Potentiometer, composition, 50 ohms ± 20%, 2.25 w, linear taper. Allen Bradley Type J.	M-2R73-P1
2R56	3000 ohms, 2 w.	C-3R79-P302J
2R57	1.0 megohm.	C-3R77-P105J
2R58	10,000 ohms.	C-3R77-P103J
	SWITCHES	
2S1	Rotary type, miniature, 1 section, 3 pole, 3 position, shorting type contacts. Centralab Series 100, Cat. #PS108.	C-5494644-P7
2S2	Slide switch, spst, nonshorting silver plated brass contacts. Oak Type 75.	B-7493820-P1
	TUBE SOCKETS	
2XV1 thru 2XV4	Mica filled, molded plastic, 9 pin miniature, 4 ground lugs. Elco Code #91662, #BRTL989PHSPTD.	B-7494154-P3

SYMBOL	DESCRIPTION	G-E DRAWING
	HIGH-VOLTAGE POWER SUPPLY SUBCHASSIS PL-7670846-G1	
	CAPACITORS (Paper, molded plastic, ± 20%, 400 v d-c w, unless otherwise specified)	
3C1	Electrolytic, tubular, 20 mfd +100% -10%, 350 v d-c w. Mallory Cat. #TC65.	C-7774786-P84
3C3	Silver mica, epoxy dipped; 100 mmfd ± 5%, 500 v d-c w.	B-7489162-P27
3C4	Silver mica, epoxy dipped; 220 mmfd ± 5%, 500 v d-c w.	B-7489162-P35
3C5	0.01 mfd. Sprague Cat. #109P10304.	B-7491096-P27
3C6	Electrolytic, tubular, 50 mfd +250% -10%, 25 v d-c w.	C-7774786-P3
3C7	0.1 mfd. Sprague Cat. #160P10404.	C-7778840-P33
3C8	Paper dielectric, hermetically sealed in metal tubular case, mineral oil impregnated, 0.1 mfd +30% -10%, 1000 v d-c w. Sprague Cat. #PPX24B69.	P-7768969-P44
3C9	0.047 mfd. Sprague Cat. #160P47304.	C-7778840-P31
3C11 thru 3C14	Ceramic, double cup, temp compensating, 500 mmfd ± 20%, 5000 v d-c w, Hi-K. Centralab Cat. #8585-500.	B-7488281-P13
3C15	Ceramic, high voltage, 500 mmfd +50% -20%, 20,000 v d-c w. Centralab Cat. #DA208.	B-7481652-P23
3C16	Ceramic, high voltage, 500 mmfd +50% -20%, 20,000 v d-c w. Centralab Cat. #DA208.	B-7481652-P33
	INDICATING LIGHTS	
3I1 thru 3I3	Glow lamps. G-E Cat. #NE-2.	A-7164423-P1
	JACKS AND RECEPTACLES	
3J1	Plug, 8 male contacts. Cinch-Jones Cat. #S-308-DB.	B-7493837-P11
3J2	Test pont jack, nylon, ivory color. EF Johnson Cat. #105-611-1.	A-7143959-P11
3J3	Disconnect, chassis mounted. Alden Products Cat. #8101FP.	A-7167289-P1
	INDUCTORS	
3L1	Coil assembly.	B-7491716-G2
3L2 and 3L3	RF choke, 10.0 uh ± 10%, 0.3 ohm max d-c resistance. Jeffers Cat. #10203-26.	B-7488079-P43
	RESISTORS (Composition, ± 5%, ½ w, unless otherwise specified)	
3R1	1.0 megohm.	C-3R77-P105J
3R2	0.10 megohm.	C-3R77-P104J
3R3	30,000 ohms.	C-3R77-P303J
3R4	0.47 megohm.	C-3R77-P474J
3R5	68 ohms.	C-3R77-P680J
3R6	Wirewound, 100 ohms ± 5%, 10 w. Sprague Type 10KT with tab terminals and Style C mtg.	M-7478633-P81
3R7	68 ohms.	C-3R77-P680J
3R8	Wirewound, 16,000 ohms ± 5%, 5 w. Sprague Type 5KT with tab terminals and Style C mtg.	M-7478632-P103
3R10	0.15 megohm.	C-3R77-P154J
3R11	0.24 megohm.	C-3R77-P244J
3R12	Potentiometer, composition, 1.0 megohm ± 20%, 2.25 w, linear taper. Allen Bradley Type J.	M-2R73-P26
3R13	2.4 megohm.	C-3R77-P245J
3R14	Wirewound, 20 ohms ± 5%, 10 w. Ward Leonard Cat. #10F20.	M-2R12-P114
3R15 and 3R16	2.4 megohm, 2 w.	C-3R79-P245J

SYMBOL	DESCRIPTION	G-E DRAWING
	RESISTORS (CONTINUED) (Composition, ± 5%, ½ w, unless otherwise specified)	
3R17 and 3R18	0.47 megohm, 2 w.	C-3R79-P474J
3R19	0.10 megohm, 2 w.	C-3R79-P104J
3R20	Composition, high-voltage, uninsulated, 250.0 megohms ± 15%, 4 w, 15,000 v max. Resistance Products Co. Type BFQ.	K-7132396-P10
	SWITCH	
3S1	Door interlock, push to operate, returns automatically; pull to operate, will not return automatically; contact rating inductive and heater loads 125 or 250 v a-c, 10 amp.	A-7141440-P1
	TRANSFORMER	
3T1	Transformer assembly.	B-7494035-G2
	TUBE SOCKETS	
3XV1	Mica filled molded plastic, 9 pin miniature, 4 ground lugs. Elco Code #91662, #BRTL989PHSPTD.	B-7494154-P3
3XV2	Octal, clover leaf contacts. Amphenol Cat. #59-103.	A-7165474-P1
3XV3	Octal, steatite. Jan Type TS101C01.	M-7408127-P2
3XV4	Octal, paper base laminated Texolite.	K-59J385-P1
3XV5 and 3XV6	Mica filled molded plastic, 9 pin miniature, 4 ground lugs. Elco Code #91662, #BRTL989PHSPTD.	B-7494154-P3
	PICTURE HORIZONTAL SWEEP SUBCHASSIS PL-7670812G1	
	CAPACITORS (Paper, molded plastic, ± 20%, 400 v d-c w, unless otherwise specified)	
4C1	0.01 mfd. Sprague Cat. #109P10304.	B-7491096-P27
4C2	Silver mica, 68 mmfd ± 5%, 500 v d-c w. Electromotive Mfg. Co. Type DM15.	B-7489162-P23
4C3	Electrolytic, 50 mfd +100% -10%, 25 v d-c w. Sprague Cat. #30D186A1.	B-7489483-P17
4C4	0.01 mfd. Sprague Cat. #109P10304.	B-7491096-P27
4C5	Silver mica, 27 mmfd ± 5%, 500 v d-c w. Electromotive Mfg. Co. Type DM15.	B-7489162-P13
4C6	0.01 mfd. Sprague Cat. #109P10304.	B-7491096-P27
4C7 and 4C8	Silver mica, 1000 mmfd ± 5%, 500 v d-c w. Electromotive Mfg. Co. Type DM20.	A-7147203-P8
4C9	0.1 mfd. Sprague Cat. #160P10404.	C-7778840-P33
4C10	Variable, ceramic, 7 to 45 mmfd, 500 v d-c w. Erie Style 503.	B-7484389-P6
4C11	0.1 mfd. Sprague Cat. #160P10404.	C-7778840-P33
4C12	Silver mica, 2200 mmfd ± 5%, 500 v d-c w. Electromotive Mfg. Co. Type DM20.	A-7147203-P16
4C13 and 4C14	0.1 mfd. Sprague Cat. #160P10404.	C-7778840-P33
4C15 and 4C16	0.01 mfd. Sprague Cat. #109P10304.	B-7491096-P27
4C17	Mylar dielectric, 0.47 mfd ± 20%, 400 v d-c w. Good-All Type 663-UW.	C-7777865-P312
4C18 and 4C19	Silver mica, epoxy dipped; 6800 mmfd ± 5%, 500 v d-c w.	B-7495258-P27
4C20 and 4C21	0.01 mfd. Sprague Cat. #109P10304.	B-7491096-P27
4C22	Silver mica, 1000 mmfd ± 5%, 500 v d-c w. Electromotive Mfg. Co. Type DM20.	A-7147203-P8

SYMBOL	DESCRIPTION	G-E DRAWING
	CAPACITORS (CONTINUED) (Paper, molded plastic, ± 20%, 400 v d-c w, unless otherwise specified)	
4C23	0.01 mfd. Sprague Cat. #109P10304.	B-7491096-P27
4C24	Silver mica, 1500 mmfd ± 5%, 500 v d-c w. Electromotive Mfg. Co. Type DM20.	A-7147203-P12
4C25 and 4C26	Silver mica, 1000 mmfd ± 5%, 500 v d-c w. Electromotive Mfg. Co. Type DM20.	A-7147203-P8
4C27	Silver mica, 330 mmfd ± 5%, 500 v d-c w. Electromotive Mfg. Co. Type DM15.	B-7489162-P39
4C28	0.01 mfd. Sprague Cat. #109P10304.	B-7491096-P27
4C29	0.1 mfd. Sprague Cat. #160P10404.	C-7778840-P33
4C31	Electrolytic, polarized twist prong base, 20-20-20-20 mfd +100% -10%, 350-350-350-350 v d-c w.	C-7776308-P42
4C32	Silver mica, 680 mmfd ± 5%, 500 v d-c w. Electromotive Mfg. Co. Type DM20.	A-7147203-P4
4C33	0.022 mfd. Sprague Cat. #106P22304.	C-7778840-P29
4C34	Mylar, dielectric, 0.22 mfd ± 20%, 600 v d-c w. Good-All Type 663-UW.	C-7777865-P410
4C35	Silver mica, epoxy dipped; 33 mmfd ± 5%, 500 v d-c w. Electromotive Type DM15.	B-7489162-P15
	RECTIFIERS	
4CR1 and 4CR2	Silicon Diodes. Hughes Type 1N629.	C-5494923-P5
	JACKS	
4J2	Test point jack, nylon, ivory color. EF Johnson Cat. #105-611-1.	A-7143959-P11
4J3	Test point jack, nylon, yellow color. EF Johnson Cat. #105-607-1.	A-7143959-P7
	INDUCTORS	
4L1	Coil assembly.	B-7493953-G1
4L2 and 4L3	RF chokes, 85.0 mh ± 5%, resistance 328 ohms ± 15%. FW Sickles Cat. #SC-106A.	K-1R15-P10
4L4	RF choke, 10.0 uh ± 10%, 0.3 ohm max d-c resistance. Jeffers Cat. #10203-26.	B-7488079-P43
	PLUGS	
4P1	Cinch-Jones Cat. #P-321-AB with polarizing pin in #11 position.	A-7167435-P2
4P4 and 4P5	Banana type.	K-7868735-P2
	RESISTORS (Composition, ± 5%, ½ w, unless otherwise specified)	
4R1	100 ohms.	C-3R77-P101J
4R2	1.0 megohm.	C-3R77-P105J
4R3	390 ohms.	C-3R77-P391J
4R4	4700 ohms.	C-3R77-P472J
4R5	13,000 ohms.	C-3R77-P133J
4R6	100 ohms.	C-3R77-P101J
4R7	1.0 megohm.	C-3R77-P105J
4R8	9100 ohms, 1 w.	C-3R78-P912J
4R9	1000 ohms.	C-3R77-P102J
4R10	1.0 megohm.	C-3R77-P105J
4R11	100 ohms.	C-3R77-P101J
4R13	47,000 ohms, 1 w.	C-3R78-P473J
4R16	1.0 megohm.	C-3R77-P105J
4R17 and 4R18	9100 ohms.	C-3R77-P912J

SYMBOL	DESCRIPTION	G-E DRAWING
	RESISTORS (CONTINUED) (Composition, ± 5%, ½ w, unless otherwise specified)	
4R19	15,000 ohms.	C-3R77-P153J
4R20	0.13 megohm.	C-3R77-P134J
4R24 and 4R25	0.10 megohm.	C-3R77-P104J
4R26	2.2 megohm.	C-3R77-P225J
4R27	0.10 megohm.	C-3R77-P104J
4R28	0.15 megohm.	C-3R77-P154J
4R29	Potentiometer, carbon film, 10,000 ohms ± 20%, 0.3 w, linear taper. Chicago Telephone Type 70 Control.	C-5494774-P4
4R32	6.2 megohm.	C-3R77-P625J
4R33	22,000 ohms.	C-3R77-P223J
4R34	56,000 ohms, 1 w.	C-3R78-P563J
4R35	27,000 ohms, 2 w.	C-3R79-P273J
4R36	47,000 ohms.	C-3R77-P473J
4R37	18,000 ohms.	C-3R77-P183J
4R38	1100 ohms.	C-3R77-P112J
4R39	56,000 ohms, 2 w.	C-3R79-P563J
4R41	100 ohms.	C-3R77-P101J
4R42	0.20 megohm.	C-3R77-P204J
4R43	10,000 ohms.	C-3R77-P103J
4R44	4700 ohms.	C-3R77-P472J
4R45	18,000 ohms.	C-3R77-P183J
4R46	1.0 megohm.	C-3R77-P105J
4R49	100 ohms.	C-3R77-P101J
4R50	22,000 ohms, 2 w.	C-3R79-P223J
4R51	1.0 megohm.	C-3R77-P105J
4R52	0.36 megohm.	C-3R77-P364J
4R53	Potentiometer, carbon film, 25,000 ohms ± 20%, 0.2 w, linear taper. Chicago Telephone Type 70 Control.	C-5494774-P5
4R54	0.47 megohm.	C-3R77-P474J
4R55	100 ohms.	C-3R77-P101J
4R57	20 ohms.	C-3R77-P200J
4R58	Wirewound, 5000 ohms ± 5%, 10 w. Ward Leonard Cat. #10F5000.	M-2R12-P38
4R59	Wirewound, 250 ohms ± 5%, 10 w. Ward Leonard Cat. #10F250.	M-2R12-P25
4R61 and 4R62	100 ohms.	C-3R77-P101J
4R63	0.16 megohm, 1 w.	C-3R78-P164J
4R64	1.0 megohm.	C-3R77-P105J
4R65	Potentiometer, composition, 250,000 ohms ± 20%, 2.25 w, linear taper. Allen Bradley Type J.	M-2R73-P22
	TUBE SOCKETS (Mica filled molded plastic, unless otherwise specified)	
4XV1 and 4XV2	9 pin miniature, 4 ground lugs. Elco Code #91662, #BRTL989PHSPTD.	B-7494154-P3
4XV3	7 pin miniature, bottom mount flat top, 4 ground lugs. Elco Code #91662, #BRTL987PHSPTD.	B-7494154-P1
4XV4 and 4XV5	9 pin miniature, 4 ground lugs. Elco Code #91662, #BRTL989PHSPTD.	B-7494154-P3
4XV6	Tube socket, octal. Amphenol Cat. #59-103 clover leaf contacts.	A-7165474-P2

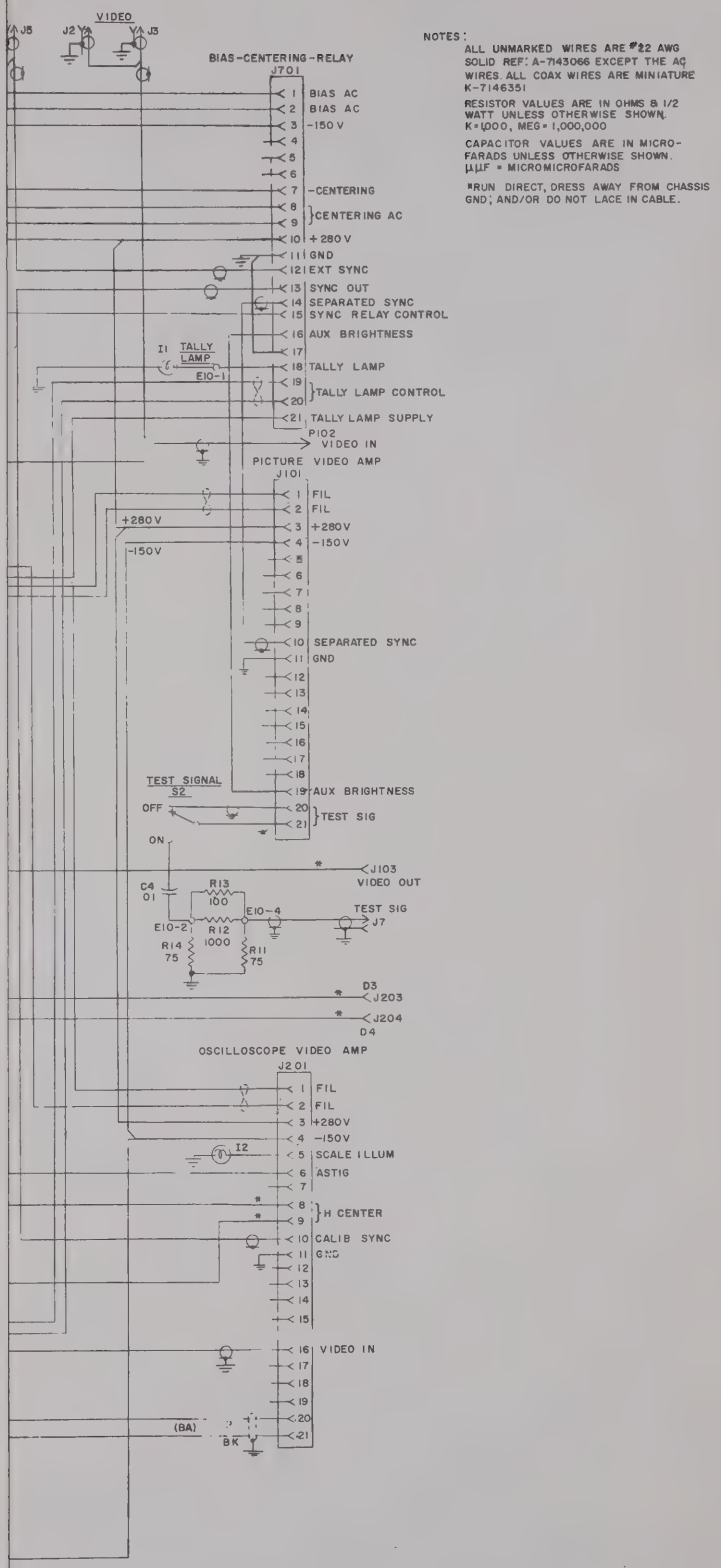
SYMBOL	DESCRIPTION	G-E DRAWING
	TUBE SOCKETS (CONTINUED) (Mica filled molded plastic, unless otherwise specified)	
4XV7	Octal, steatite. Jan Type TS101C01.	B-7408127-P2
	PICTURE VERTICAL SWEEP SUBCHASSIS PL-7670811-G1	
	CAPACITORS (Paper, molded plastic, ± 20%, 400 v d-c w, unless otherwise specified)	
5C1	Mylar, dielectric, 0.1 mfd ± 20%, 100 v d-c w. G-E Type 61F.	B-7491930-P9
5C2	0.01 mfd. Sprague Cat. #109P10304.	B-7491096-P27
5C3 and 5C4	Silver mica, 10 mmfd ± 5%, 500 v d-c w. Electromotive Mfg. Co. Type DM15.	B-7489162-P6
5C5	Silver mica, 100 mmfd ± 5%, 500 v d-c w. Electromotive Mfg. Co. Type DM15.	B-7489162-P27
5C6	0.01 mfd. Sprague Cat. #109P10304.	B-7491096-P27
5C7	Electrolytic, 5.0 mfd +100% -10%, 25 v d-c w. Sprague Cat. #30D179A1.	B-7489483-P6
5C8	0.01 mfd. Sprague Cat. #109P10304.	B-7491096-P27
5C9	Mylar, metallized, 4.0 mfd ± 20%, 100 v d-c w. Good-All Type X663F.	B-7493817-P2
5C10 thru 5C12	Mylar, dielectric, 0.15 mfd ± 20%, 400 v d-c w. Good-All Type 663-UW.	C-7777865-P317
5C13	Mylar, metallized, 1.0 mfd ± 10%, 400 v d-c w. Good-All Type X663F.	B-7493817-P1
5C14 and 5C15	Mylar, dielectric, 0.01 mfd ± 20%, 100 v d-c w. G-E Type 61F.	B-7491930-P5
5C16	Mylar, metallized, 1.0 mfd ± 10%, 400 v d-c w. Good-All Type X663F.	B-7493817-P1
5C18	Electrolytic, polarized, 2500 mfd +250% -10%, 6 v d-c w. Mallory Cat. #TC.	C-7775849-P15
5C19	0.047 mfd. Sprague Cat. #160P47304.	C-7778840-P31
5C20	Silver mica, epoxy dipped; 6800 mmfd ± 5%, 500 v d-c w.	B-7495258-P27
5C21	Mylar, dielectric, 0.01 mfd ± 20%, 100 v d-c w. G-E Type 61F.	B-7491930-P5
5C22	Mylar, dielectric, 0.22 mfd ± 20%, 400 v d-c w. Good-All Type 663-UW.	C-7777865-P310
5C23	0.01 mfd. Sprague Cat. #109P10304.	B-7491096-P27
5C24	Electrolytic, polarized, 2500 mfd +250% -10%, 6 v d-c w. Mallory Cat. #TC.	C-7775849-P15
	RECTIFIER	
5CR1	Germanium. G-E Type 1N91.	C-7777664-P1
	INDICATING LIGHT	
5I1	Glow lamp. G-E Type NE-2.	A-7164423-P1
	RELAY	
5K1	Pickup 5 ma or less, coil rated 10 ma continuous, resistance 10,000 ohms ± 10%, twin 2 form C contacts. Automatic Electric Type SQA.	B-7485625-P6
	INDUCTOR	
5L1	RF coil, 200 uh ± 10%, 30 ohms max d-c resistance. Delevan Co. 3500 Series.	B-7491382-P108
	PLUG	
5P1	Cinch-Jones Cat. #P-321-AB with polarizing pin in #11 position.	A-7167435-P2

SYMBOL	DESCRIPTION	G-E DRAWING
	RESISTORS (Composition, ± 5%, ½ w, unless otherwise specified)	
5R1	1.0 megohm.	C-3R77-P105J
5R3	0.10 megohm.	C-3R77-P104J
5R6	0.15 megohm.	C-3R77-P154J
5R7 and 5R8	0.30 megohm.	C-3R77-P304J
5R9	47,000 ohms.	C-3R77-P473J
5R10	10,000 ohms.	C-3R77-P103J
5R11	1.0 megohm.	C-3R77-P105J
5R12	0.10 megohm.	C-3R77-P104J
5R13	1.0 megohm.	C-3R77-P105J
5R14	10,000 ohms.	C-3R77-P103J
5R16	47,000 ohms.	C-3R77-P473J
5R17 and 5R18	1.0 megohm.	C-3R77-P105J
5R21	91,000 ohms.	C-3R77-P913J
5R22	27,000 ohms.	C-3R77-P273J
5R23	560 ohms.	C-3R77-P561J
5R24	1.0 megohm.	C-3R77-P105J
5R25	0.33 megohm.	C-3R77-P334J
5R26	10,000 ohms.	C-3R77-P103J
5R28	27,000 ohms.	C-3R77-P273J
5R29	560 ohms.	C-3R77-P561J
5R30 and 5R31	100 ohms.	C-3R77-P101J
5R32	430 ohms, 2 w.	C-3R79-P431J
5R33	1.0 megohm.	C-3R77-P105J
5R36	56 ohms, 2 w.	C-3R79-P560J
5R37 and 5R38	30 ohms, 2 w.	C-3R79-P300J
5R40	10,000 ohms.	C-3R77-P103J
5R42	0.20 megohm.	C-3R77-P204J
5R43	Wirewound, 20,000 ohms ± 5%, 5 w. Sprague Type 5KT with tab terminals and Style C mtg.	M-7478632-P104
5R44	30,000 ohms.	C-3R77-P303J
5R45	0.27 megohm.	C-3R77-P274J
5R46	100 ohms.	C-3R77-P101J
	TRANSFORMER	
5T1	Vertical sweep. Pri inductance: 30 h min at 100 v RMS, 60 cps with 35 ma flowing in the pin; pri d-c resistance: 500 ohms max; sec d-c resistance: 11 ohms max.	B-7493853-P1
	TRANSISTOR SOCKET	
5XQ1	Elco Corp. Cat. #3301.	B-7495897-P4
	TUBE SOCKETS	
5XV1 thru 5XV4	Mica filled molded plastic, 9 pin miniature, 4 ground lugs. Elco Code 91662, #BRTL989PHSPTD.	B-7494154-P3

SYMBOL	DESCRIPTION	G-E DRAWING
	OSCILLOSCOPE SWEEP SUBCHASSIS PL-7670813-G1	
	CAPACITORS (Mylar, dielectric, ± 20%, 100 v d-c w, unless otherwise specified)	
6C1	Paper, molded plastic, 0.01 mfd ± 20%, 400 v d-c w. Sprague Cat. #109P10304.	B-7491096-P27
6C3	Paper, molded plastic, 0.1 mfd ± 20%, 400 v d-c w. Sprague Cat. #160P10404.	C-7778840-P33
6C4	0.01 mfd. G-E Type 61F.	B-7491930-P5
6C5	1.0 mfd. G-E Type 61F.	B-7491930-P13
6C8 thru 6C10	0.22 mfd, 400 v d-c w. Good-All Type 663-UW.	C-7777865-P310
6C12 thru 6C14	0.47 mfd, 400 v d-c w. Good-All Type 663-UW.	C-7777865-P312
6C15	Variable, ceramic, 7 to 45 mmfd, 500 v d-c w. Erie Style 503.	M-7484389-P6
6C16	Ceramic, Hi-K disk, 500 mmfd ± 20%, 6000 v d-c w.	B-7493821-P3
6C17	Ceramic, double cup, temp compensating, 500 mmfd ± 20%, 5000 v d-c w, Hi-K temp coef. Centralab Cat. #8585-500.	B-7488281-P13
6C18	Mylar, metallized, 1.0 mfd ± 10%, 400 v d-c w. Good-All Type X663F.	B-7493817-P1
6C19 and 6C20	Ceramic, Hi-K disk, 500 mmfd ± 20%, 6000 v d-c w.	B-7493821-P3
6C21	Ceramic, Hi-K disk, 0.1 mfd +80% -25%, 500 v d-c w. Sprague Cat. #36C190A.	B-7488160-P3
	RECTIFIER	
6CR1	Germanium rectifier. G-E Type 1N91.	C-7777664-P1
	INDICATING LIGHTS	
6I1 and 6I2	Glow lamps. G-E Cat. #NE-2.	A-7164423-P1
	PLUGS	
6P1	Cinch-Jones Cat. #P-321-AB with polarizing pin in #11 position.	A-7167435-P2
6P2 thru 6P5	Banana type.	K-7868735-P2
	RESISTORS (Composition, ± 5%, ½ w, unless otherwise specified)	
6R1	1.1 megohm.	C-3R77-P115J
6R2	0.16 megohm.	C-3R77-P164J
6R3	100 ohms.	C-3R77-P101J
6R4	11,000 ohms.	C-3R77-P113J
6R5	68,000 ohms, 1 w.	C-3R78-P683J
6R7	Potentiometer, carbon film, 250,000 ohms ± 20%, 0.2 w, linear taper. Chicago Telephone Type 70 Control.	C-5494774-P8
6R8	0.10 megohm.	C-3R77-P104J
6R9	Potentiometer, carbon film, 250,000 ohms ± 20%, 0.2 w, linear taper. Chicago Telephone Type 70 Control.	C-5494774-P8
6R10	0.39 megohm.	C-3R77-P394J
6R11	0.10 megohm.	C-3R77-P104J
6R12	1.0 megohm.	C-3R77-P105J

SYMBOL	DESCRIPTION	G-E DRAWING
	RESISTORS (CONTINUED) (Composition, ± 5%, ½ w, unless otherwise specified)	
6R13	1.5 megohm.	C-3R77-P155J
6R14	20,000 ohms.	C-3R77-P203J
6R15	0.10 megohm.	C-3R77-P104J
6R16	4.7 megohm.	C-3R77-P475J
6R17	Potentiometer, carbon film, 10,000 ohms ± 20%, 0.3 w, linear taper. Chicago Telephone Type 70 Control.	C-5494774-P4
6R18	0.15 megohm.	C-3R77-P154J
6R19	2000 ohms.	C-3R77-P202J
6R20	0.15 megohm.	C-3R77-P154J
6R21	Potentiometer, carbon film, 25,000 ohms ± 20%, 0.2 w, linear taper. Chicago Telephone Type 70 Control.	C-5494774-P5
6R22	0.22 megohm.	C-3R77-P224J
6R23	0.10 megohm.	C-3R77-P104J
6R24	4700 ohms.	C-3R77-P472J
6R26	3300 ohms.	C-3R77-P332J
6R27	1.1 megohm.	C-3R77-P115J
6R28	Potentiometer, carbon film, 50,000 ohms ± 20%, 0.2 w, linear taper. Chicago Telephone Type 70 Control.	C-5494774-P6
6R29 and 6R30	2.2 megohm.	C-3R77-P225J
6R31	100 ohms.	C-3R77-P101J
6R32	750 ohms.	C-3R77-P751J
6R33	10,000 ohms, 1 w.	C-3R78-P103J
6R35	2.2 megohm.	C-3R77-P225J
6R36	100 ohms.	C-3R77-P101J
6R37	0.20 megohm.	C-3R77-P204J
6R38	36,000 ohms, 2 w.	C-3R79-P363J
6R39	47,000 ohms, 2 w.	C-3R79-P473J
6R40	0.22 megohm.	C-3R77-P224J
6R41	1.0 megohm.	C-3R77-P105J
6R42	0.30 megohm.	C-3R77-P304J
6R43	Potentiometer, composition, 500,000 ohms ± 20%, 2.25 w, linear taper. Allen Bradley Type J.	M-2R73-P64
6R44	47,000 ohms.	C-3R77-P473J
6R45	Potentiometer, composition, 5.0 megohm ± 20%, 2.25 w, linear taper. Allen Bradley Type J.	M-2R73-P71
6R46	Composition, high voltage, 35.0 megohm ± 15%, 2 w. 7500 v max. Resistance Products Type BBM.	A-7132396-P2
6R47	20,000 ohms.	C-3R77-P203J
6R48	2.0 megohm.	C-3R77-P205J
	SWITCHES	
6S1	Rotary type, subminiature, 4 pole, 3 position, 2 section; nonshorting.	B-7493886AB-P1
6S2	Rotary type, dpdt, nonshorting. Oak Type 22.	B-7488282-P2

SYMBOL	DESCRIPTION	G-E DRAWING
	TRANSISTOR SOCKETS	
6XQ1 and 6XQ2	Elco Cat. #3303.	B-7495897-P1
	TUBE SOCKETS	
6XV1 thru 6XV3	Mica filled molded plastic, 9 pin miniature, 4 ground lugs. Elco Code 91662, #BRTL989PHSPTD.	B-7494154-P3
6XV4	Special 9 pin, mica filled.	K-71J622-P1
	BIAS-CENTERING-RELAY SUBCHASSIS PL-7778021-G1	
	CAPACITORS (Electrolytic, polarized twist prong base)	
7C1	20-20-20 mfd +100% -10%, 350-350-350 v d-c w.	C-7776308-P134
7C2	3000 mfd +250% -10%, 10 v d-c w.	C-7776308-P104
7C3	1000 mfd +250% -10%, 15 v d-c w.	C-7776308-P103
	RECTIFIERS	
7CR1 thru 7CR4	Silicon rectifiers, half wave, hermetically sealed, max forward drop 0.9 v d-c, 400 v peak max voltage. G-E Type 1N1695.	B-5490415-P2
7CR9 thru 7CR12	Germanium rectifiers, low current. G-E Type 1N91.	C-7777664-P1
7CR13	Texas Instrument Corp. Type 1N750A.	A-7164424-P48
	RELAY	
7K1	2 form C contacts, 60 v coil, 6500 ohms resistance. CP Clare Type SK5161.	P-7771197-P6
	PLUGS	
7P1	Cinch-Jones Cat. #P-321-AB with polarizing pin in #11 position.	A-7167435-P2
7P10	Male contacts, black phenolic. Amphenol Type 86-CP8.	M-7478610-P6
	RESISTORS (Composition, ± 5%, ½ w, unless otherwise specified)	
7R1	220 ohms, 2 w.	C-3R79-P221J
7R2 thru 7R4	1800 ohms, 2 w.	C-3R79-P182J
7R5	39 ohms.	C-3R77-P390J
7R6	18 ohms.	C-3R77-P180J
7R8 and 7R9	12,000 ohms, 2 w.	C-3R79-P123J
7R10	18,000 ohms.	C-3R77-P183J
	RELAY SOCKETS	
7XK1 and 7XK2	Mica filled phenolic, octal. Cinch Type 9886.	K-7103053-P1
	TRANSISTOR SOCKET	
7XQ1	Transistor socket assembly.	A-7167056-G1
	TUBE SOCKET	
7XV1	Mica filled molded plastic, 7 pin miniature, 4 ground lugs. Elco Code 91662, #BRTL987PHSPTD.	B-7494154-P1



NOTES:

ALL UNMARKED WIRES ARE #22 AWG SOLID REF: A-7143066 EXCEPT THE AC WIRES ALL COAX WIRES ARE MINIATURE K-7146351

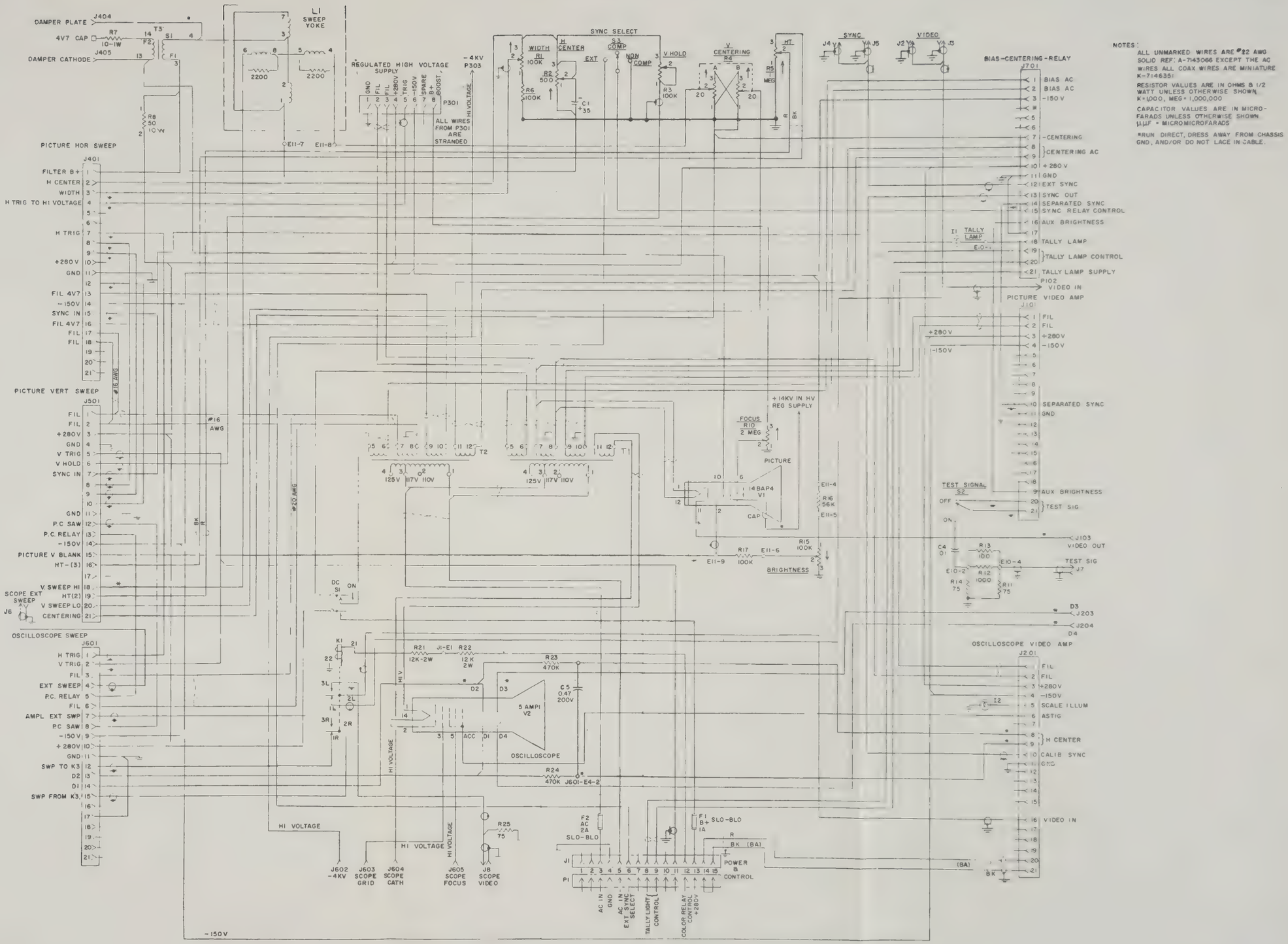
RESISTOR VALUES ARE IN OHMS & 1/2 WATT UNLESS OTHERWISE SHOWN. K=1000, MEG=1,000,000

CAPACITOR VALUES ARE IN MICROFARADS UNLESS OTHERWISE SHOWN. μμF = MICROMICROFARADS

*RUN DIRECT, DRESS AWAY FROM CHASSIS GND; AND/OR DO NOT LACE IN CABLE.

1 (E-7354649, Rev. F)

Fig. 19
Elementary
Main Chassis



NOTES:

ALL UNMARKED WIRES ARE #22 AWG SOLID REF: A-7143066 EXCEPT THE AC WIRES ALL COAX WIRES ARE MINIATURE K-7146351

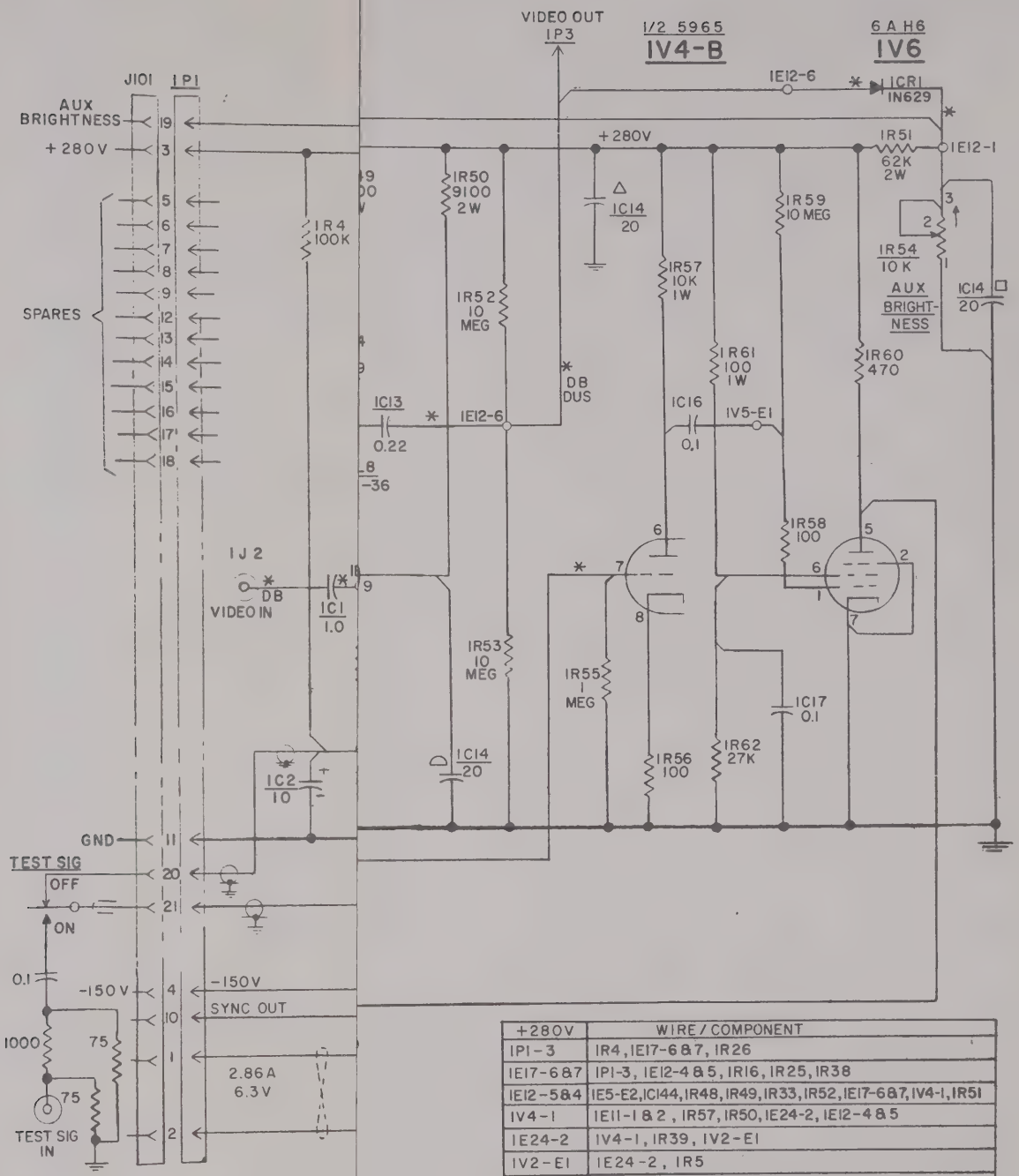
RESISTOR VALUES ARE IN OHMS & 1/2 WATT UNLESS OTHERWISE SHOWN. K=1000, MEG=1,000,000

CAPACITOR VALUES ARE IN MICRO-FARADS UNLESS OTHERWISE SHOWN. µµF = MICROMICROFARADS

*RUN DIRECT, DRESS AWAY FROM CHASSIS GND, AND/OR DO NOT LACE IN CABLE.

Fig. 19 Elementary Diagram, Main Chassis, Master Monitor, Model 4TM21A1 (E-7354649, Rev. F)

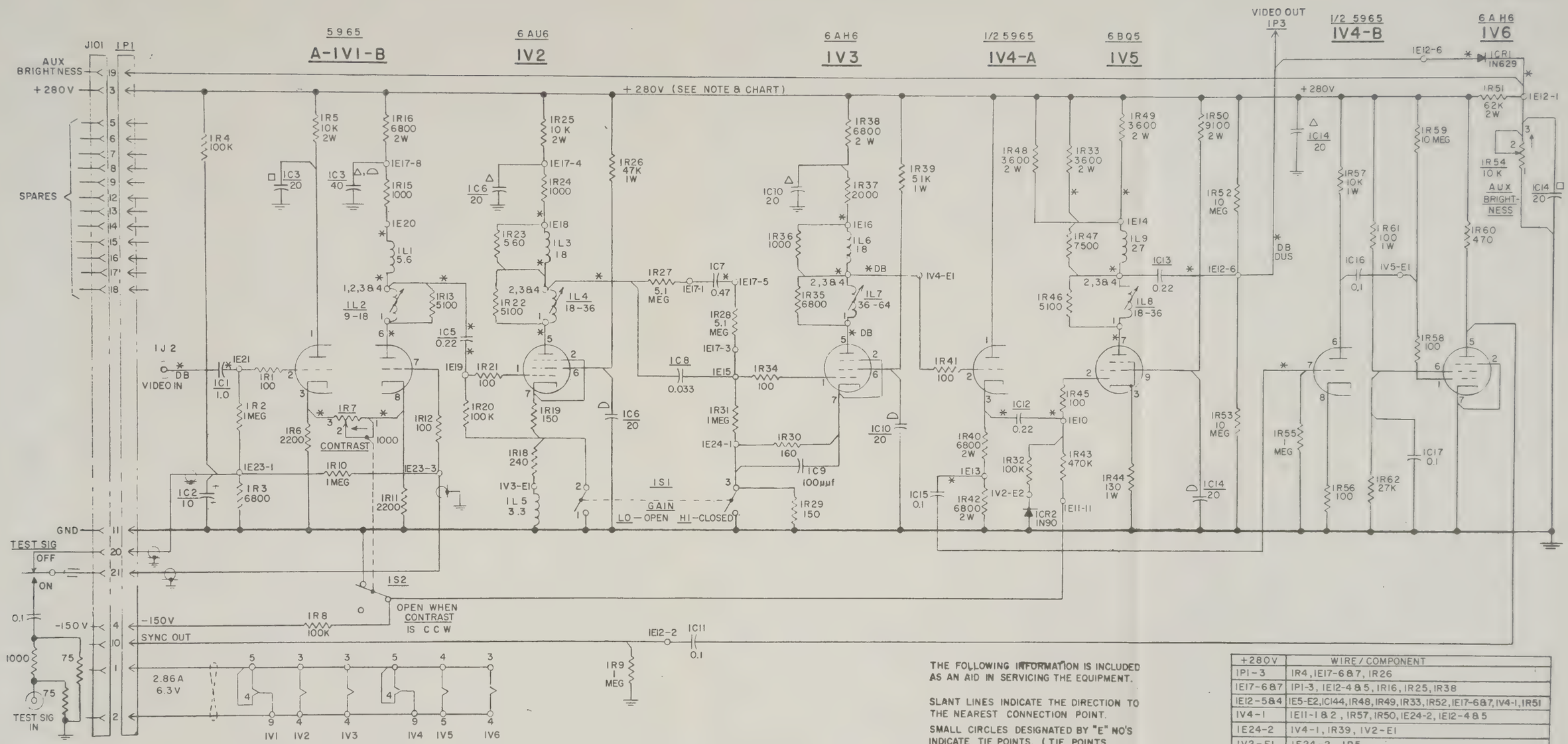
Fig. 19
Elementary
Main Chassis



+280V	WIRE / COMPONENT
1P1-3	1R4, 1E17-6&7, 1R26
1E17-6&7	1P1-3, 1E12-4&5, 1R16, 1R25, 1R38
1E12-5&4	1E5-E2, 1C144, 1R48, 1R49, 1R33, 1R52, 1E17-6&7, 1V4-1, 1R51
1V4-1	1E11-1&2, 1R57, 1R50, 1E24-2, 1E12-4&5
1E24-2	1V4-1, 1R39, 1V2-E1
1V2-E1	1E24-2, 1R5
1V5-E2	1R59, 1R60, 1R61, 1E12-4&5

IN THE B+ CHART ABOVE, THE RIGHT COLUMN CONTAINS COMPONENTS & WIRES THAT MUST TERMINATE AT THE B+ POINTS INDICATED IN THE LEFT COLUMN.

Fig. 20
Elementary
Picture Video
Amplifier



NOTE: ALL #22 WIRES ARE SN22
*=KEEP LEADS SHORT

THE FOLLOWING INFORMATION IS INCLUDED AS AN AID IN SERVICING THE EQUIPMENT.

SLANT LINES INDICATE THE DIRECTION TO THE NEAREST CONNECTION POINT.

SMALL CIRCLES DESIGNATED BY "E" NO'S INDICATE TIE POINTS. (TIE POINTS PHYSICALLY MOUNTED ON COMPONENTS OR TUBE SOCKETS ARE PRECEDED BY THE COMPONENT OR SOCKET SYMBOL.)

RESISTOR VALUES ARE IN OHMS & 1/2 WATT UNLESS OTHERWISE SHOWN.
K = 1,000 OHMS MEG = 1,000,000 OHMS

CAPACITOR VALUES ARE IN MICROFARADS UNLESS OTHERWISE SHOWN.
μμf = MICROMICROFARADS

COIL VALUES ARE IN MICROHENRIES UNLESS OTHERWISE SHOWN.
MH = MILLIHENRIES HY = HENRIES

ALL COMPONENTS MECHANICALLY MOUNTED ARE UNDERLINED.

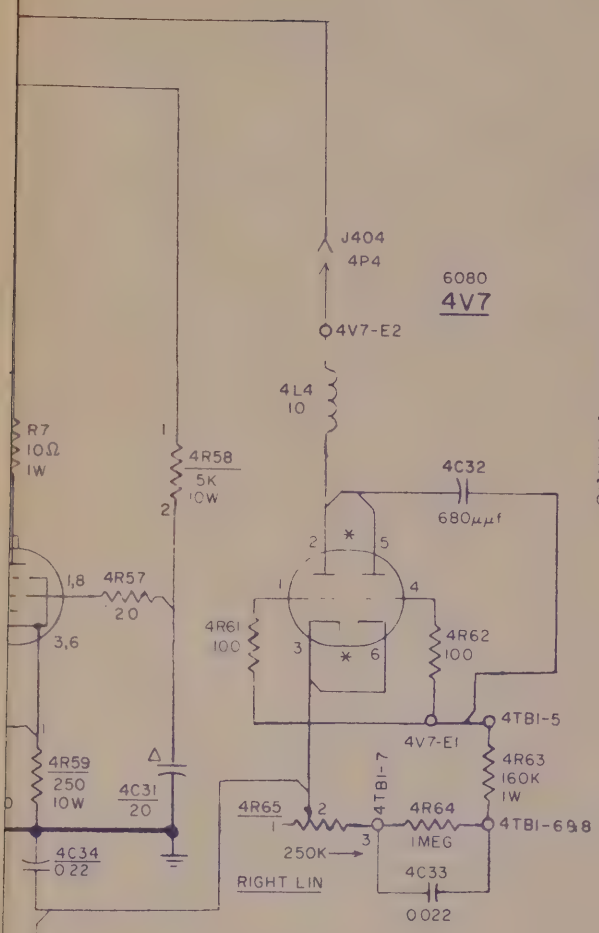
*RUN DIRECT, DRESS AWAY FROM CHASSIS GND; AND/OR DO NOT LACE IN CABLE.

+280V	WIRE / COMPONENT
1P1-3	IR4, 1E17-6&7, IR26
1E17-6&7	1P1-3, 1E12-4&5, IR16, IR25, IR38
1E12-5&4	1E5-E2, IC144, IR48, IR49, IR33, IR52, 1E17-6&7, 1V4-1, IR51
1V4-1	1E11-1&2, IR57, IR50, 1E24-2, 1E12-4&5
1E24-2	1V4-1, IR39, 1V2-E1
1V2-E1	1E24-2, IR5
1V5-E2	IR59, IR60, IR61, 1E12-4&5

IN THE B+ CHART ABOVE, THE RIGHT COLUMN CONTAINS COMPONENTS & WIRES THAT MUST TERMINATE AT THE B+ POINTS INDICATED IN THE LEFT COLUMN.

Fig. 20 Elementary Diagram, Picture Video Amplifier Subchassis (D-7670819, Rev. D)

Fig. 20 Elementary Picture Video Amplifier



RESISTOR VALUES ARE IN OHMS & 1/2 WATT UNLESS OTHERWISE SHOWN.
K = 1000, MEG = 1,000,000

CAPACITOR VALUES ARE IN MICROFARADS UNLESS OTHERWISE SHOWN.
uuf = MICROMICROFARADS.

COIL VALUES ARE IN MICROHENRIES UNLESS OTHERWISE SHOWN

MH = MILIHENRIES

ALL COMPONENTS MECHANICALLY MOUNTED ARE UNDERLINED.

SLANT LINES INDICATE THE DIRECTION TO THE NEAREST CONNECTION POINT. SMALL CIRCLES DESIGNATED BY E NUMBERS INDICATE TIE POINTS. (TIE POINTS PHYSICALLY MOUNTED ON COMPONENTS OR TUBE SOCKETS ARE PRECEDED BY THE COMPONENT OR SOCKET SYMBOL).

* SLEEVE & SEPERATE THESE 2 WIRES 1/4" MIN

NOTE
ALL #22 WIRES ARE SOLID (SN22)
ALL COAX WIRE IS RG 174/U

Fig. 21
Elementary
Picture Horizontal
Sweep and AFC

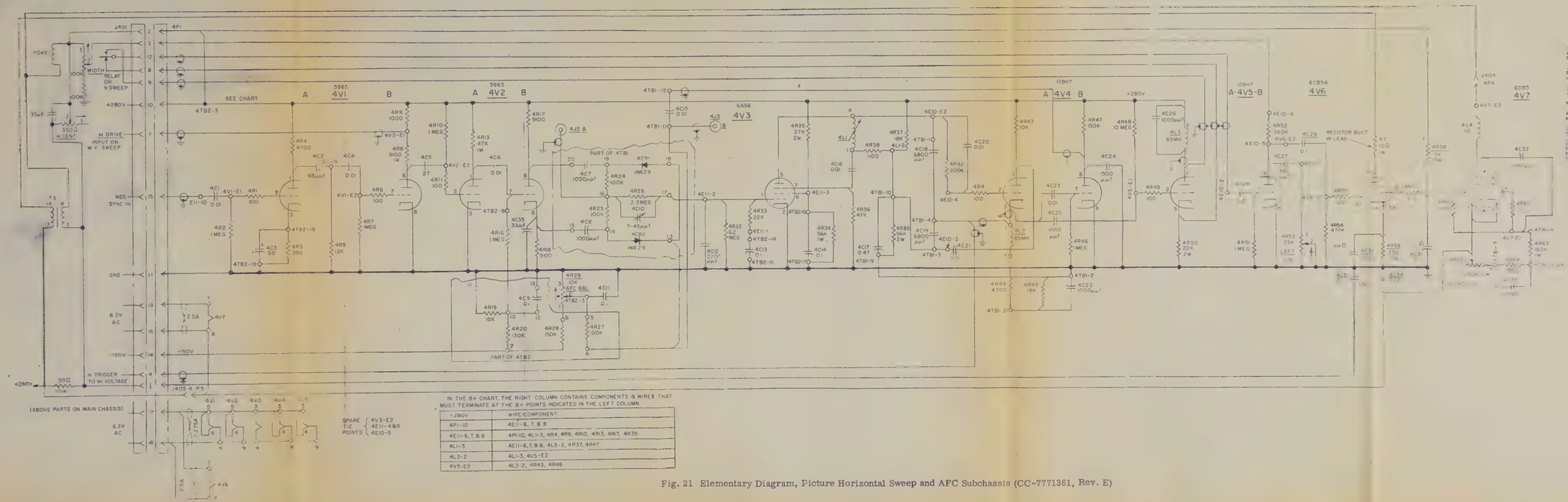
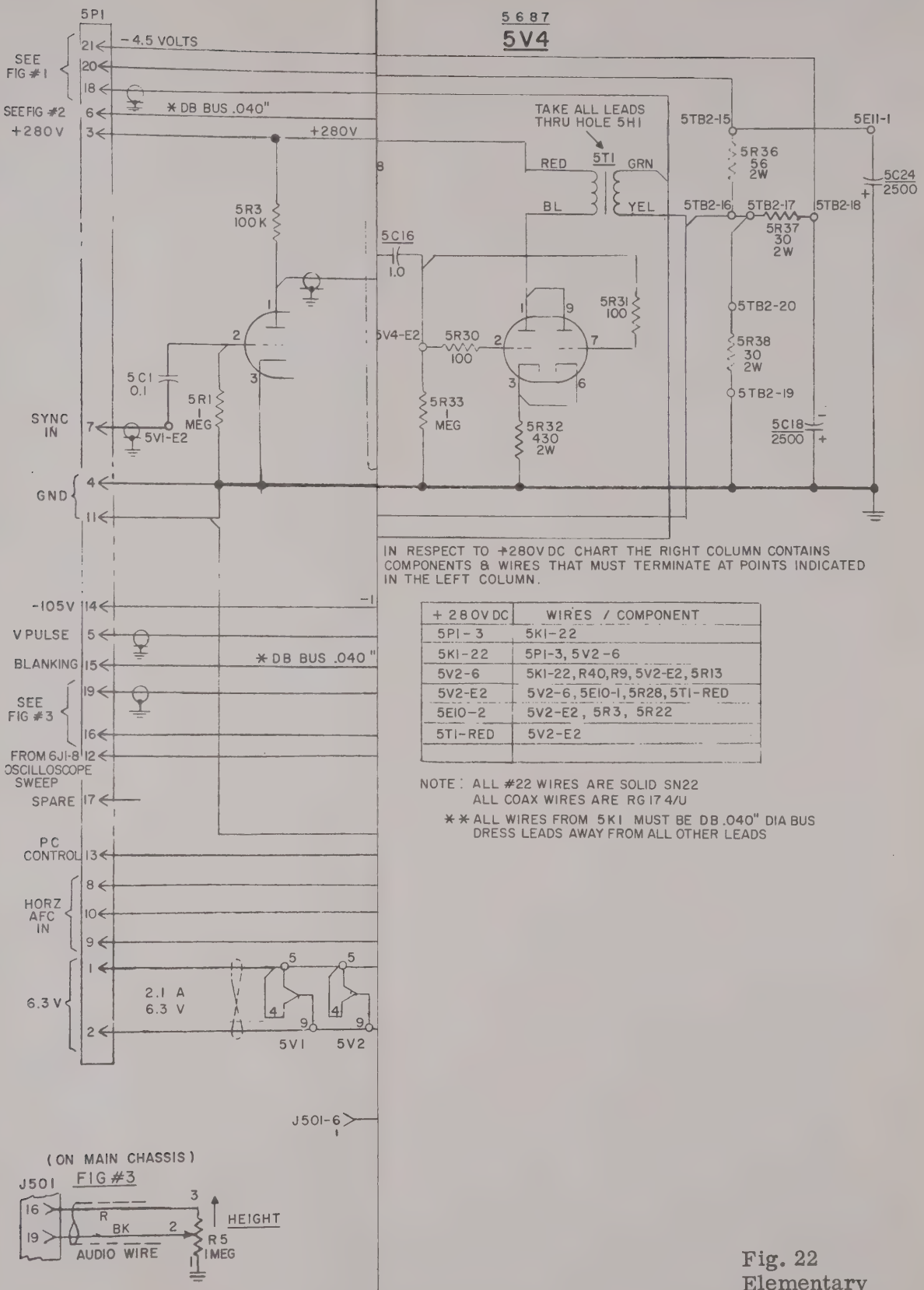


Fig. 21 Elementary Diagram, Picture Horizontal Sweep and AFC Subchassis (CC-7771361, Rev. E)

Fig. 21
Elementary
Picture Horizontal
Sweep and AFC



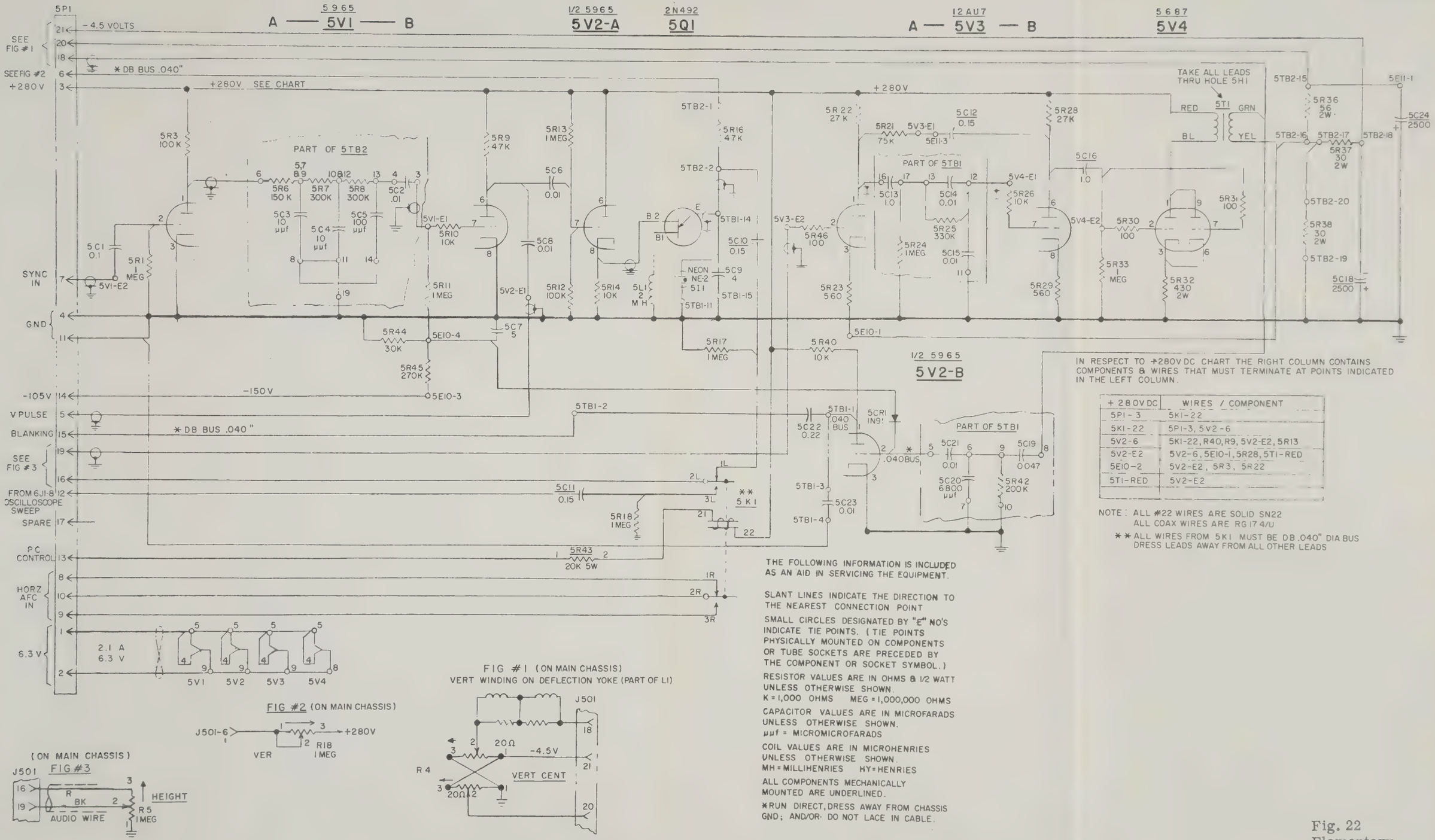
IN RESPECT TO +280V DC CHART THE RIGHT COLUMN CONTAINS COMPONENTS & WIRES THAT MUST TERMINATE AT POINTS INDICATED IN THE LEFT COLUMN.

+280V DC	WIRES / COMPONENT
5P1-3	5K1-22
5K1-22	5P1-3, 5V2-6
5V2-6	5K1-22, R40, R9, 5V2-E2, 5R13
5V2-E2	5V2-6, 5E10-1, 5R28, 5T1-RED
5E10-2	5V2-E2, 5R3, 5R22
5T1-RED	5V2-E2

NOTE: ALL #22 WIRES ARE SOLID SN22
ALL COAX WIRES ARE RG 174/U

** ALL WIRES FROM 5K1 MUST BE DB .040" DIA BUS DRESS LEADS AWAY FROM ALL OTHER LEADS

Fig. 22
Elementary
Picture Vertical
Sweep



IN RESPECT TO +280V DC CHART THE RIGHT COLUMN CONTAINS COMPONENTS & WIRES THAT MUST TERMINATE AT POINTS INDICATED IN THE LEFT COLUMN.

+280V DC	WIRES / COMPONENT
5P1-3	5K1-22
5K1-22	5P1-3, 5V2-6
5V2-6	5K1-22, R40, R9, 5V2-E2, 5R13
5V2-E2	5V2-6, 5E10-1, 5R28, 5T1-RED
5E10-2	5V2-E2, 5R3, 5R22
5T1-RED	5V2-E2

NOTE: ALL #22 WIRES ARE SOLID SN22
ALL COAX WIRES ARE RG 174/U

** ALL WIRES FROM 5K1 MUST BE DB .040" DIA BUS DRESS LEADS AWAY FROM ALL OTHER LEADS

THE FOLLOWING INFORMATION IS INCLUDED AS AN AID IN SERVICING THE EQUIPMENT.

SLANT LINES INDICATE THE DIRECTION TO THE NEAREST CONNECTION POINT

SMALL CIRCLES DESIGNATED BY "E" NO'S INDICATE TIE POINTS. (TIE POINTS PHYSICALLY MOUNTED ON COMPONENTS OR TUBE SOCKETS ARE PRECEDED BY THE COMPONENT OR SOCKET SYMBOL.)

RESISTOR VALUES ARE IN OHMS & 1/2 WATT UNLESS OTHERWISE SHOWN.
K = 1,000 OHMS MEG = 1,000,000 OHMS

CAPACITOR VALUES ARE IN MICROFARADS UNLESS OTHERWISE SHOWN.
µµf = MICROMICROFARADS

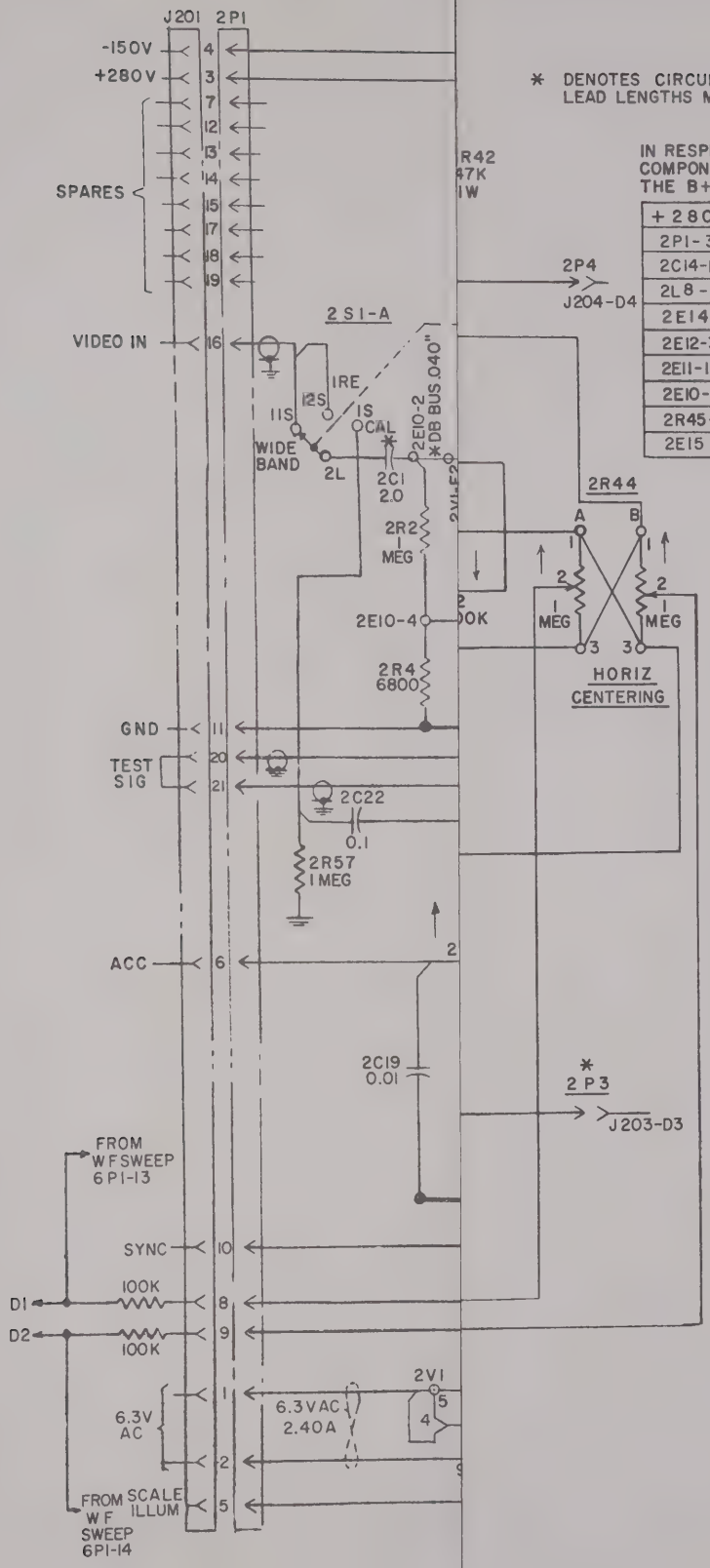
COIL VALUES ARE IN MICROHENRIES UNLESS OTHERWISE SHOWN.
MH = MILLIHENRIES HY = HENRIES

ALL COMPONENTS MECHANICALLY MOUNTED ARE UNDERLINED.

*RUN DIRECT, DRESS AWAY FROM CHASSIS GND; AND/OR· DO NOT LACE IN CABLE.

Fig. 22 Elementary Diagram, Picture Vertical Sweep Subchassis (D-7670830, Rev. C)

Fig. 22
Elementary
Picture Vertical
Sweep



* DENOTES CIRCUITS IN WHICH THE CAPACITY TO GND & LEAD LENGTHS MUST BE KEPT AT AN ABSOLUTE MINIMUM.

IN RESPECT TO B+ THE RIGHT COLUMN CONTAINS COMPONENTS & WIRES THAT MUST TERMINATE AT THE B+ POINTS INDICATED IN THE LEFT COLUMN.

+280V	WIRE / COMPONENT
2P1-3	2L8-2, 2C14-□
2C14-□	2P1-3, 2E12-3, 2E14, 2R29, 2E15
2L8-2	2P1-3, 2R43, 2R40
2E14	2R33, 2R34
2E12-3	2C14-□, 2R38, 2E11-1 & 2
2E11-1&2	2E12-3, 2E10-1, 2R21, 2R23, 2R25
2E10-1	2E11-1 & 2, 2R3, 2R7, 2R14, 2R46, 2R45-3
2R45-3	2E10-1, 2R47
2E15	2R36, 2R56

THE FOLLOWING INFORMATION IS INCLUDED AS AN AID IN SERVICING THE EQUIPMENT.

SLANT LINES INDICATE THE DIRECTION TO THE NEAREST CONNECTION POINT.

SMALL CIRCLES DESIGNATED BY "E" NO'S INDICATE TIE POINTS. (TIE POINTS PHYSICALLY MOUNTED ON COMPONENTS OR TUBE SOCKETS ARE PRECEDED BY THE COMPONENT OR SOCKET SYMBOL.)

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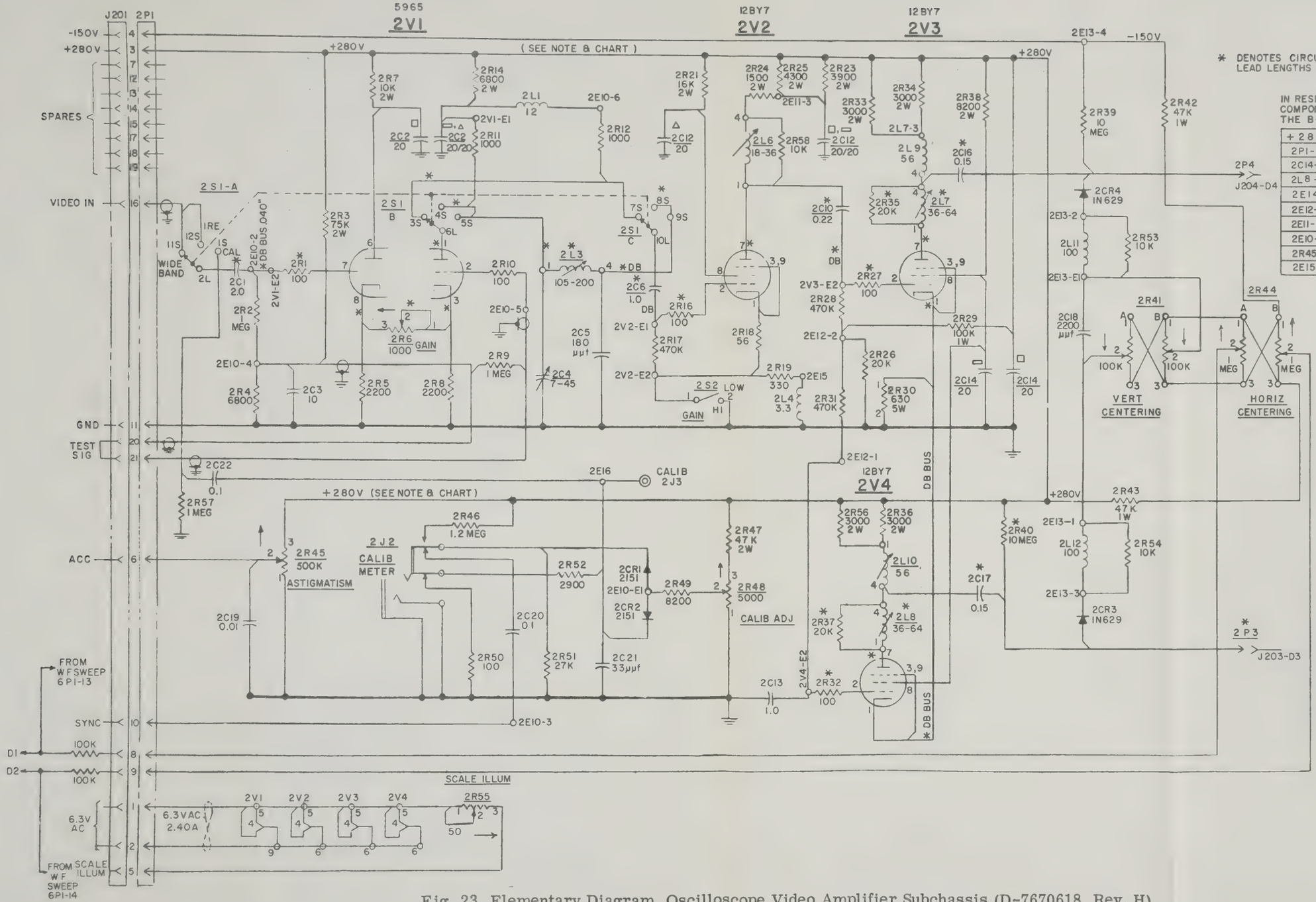
ALL COMPONENTS MECHANICALLY MOUNTED ARE UNDERLINED.

*RUN DIRECT, DRESS AWAY FROM CHASSIS GND; AND/OR DO NOT LACE IN CABLE.

Fig. 23
Elementary
Oscilloscope Video
Amplifier



* DENOTES CIRCUITS IN WHICH THE CAPACITY TO GND & LEAD LENGTHS MUST BE KEPT AT AN ABSOLUTE MINIMUM.

IN RESPECT TO B+ THE RIGHT COLUMN CONTAINS COMPONENTS & WIRES THAT MUST TERMINATE AT THE B+ POINTS INDICATED IN THE LEFT COLUMN.

+280V	WIRE / COMPONENT
2P1-3	2L8-2, 2C14-□
2C14-□	2P1-3, 2E12-3, 2E14 , 2R29, 2E15
2L8-2	2P1-3, 2R43, 2R40
2E14	2R33, 2R34
2E12-3	2C14-□, 2R38, 2E11-1 & 2
2E11-1&2	2E12-3, 2E10-1, 2R21, 2R23, 2R25
2E10-1	2E11-1 & 2, 2R3, 2R7, 2R14, 2R46, 2R45-3
2R45-3	2E10-1, 2R47
2E15	2R36, 2R56

THE FOLLOWING INFORMATION IS INCLUDED AS AN AID IN SERVICING THE EQUIPMENT.

SLANT LINES INDICATE THE DIRECTION TO THE NEAREST CONNECTION POINT.

SMALL CIRCLES DESIGNATED BY "E" NO'S INDICATE TIE POINTS. (TIE POINTS PHYSICALLY MOUNTED ON COMPONENTS OR TUBE SOCKETS ARE PRECEDED BY THE COMPONENT OR SOCKET SYMBOL.)

RESISTOR VALUES ARE IN OHMS & 1/2 WATT UNLESS OTHERWISE SHOWN.
K = 1,000 OHMS MEG = 1,000,000 OHMS

CAPACITOR VALUES ARE IN MICROFARADS UNLESS OTHERWISE SHOWN.
μμf = MICROMICROFARADS

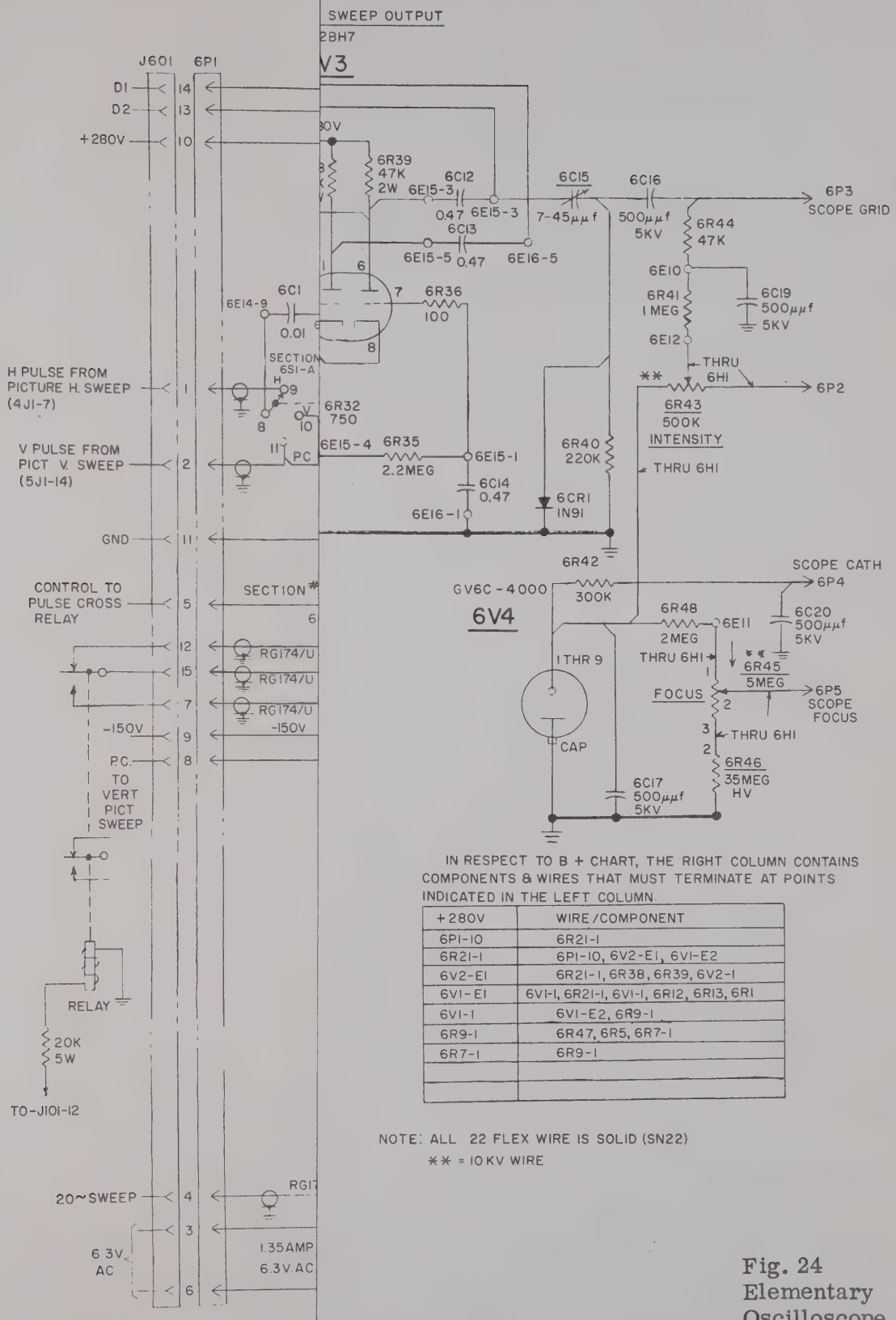
COIL VALUES ARE IN MICROHENRIES UNLESS OTHERWISE SHOWN.
MH = MILLIHENRIES HY = HENRIES

ALL COMPONENTS MECHANICALLY MOUNTED ARE UNDERLINED.

*RUN DIRECT, DRESS AWAY FROM CHASSIS GND; AND/OR DO NOT LACE IN CABLE.

Fig. 23 Elementary Diagram, Oscilloscope Video Amplifier Subchassis (D-7670618, Rev. H)

Fig. 23
Elementary
Oscilloscope Video
Amplifier

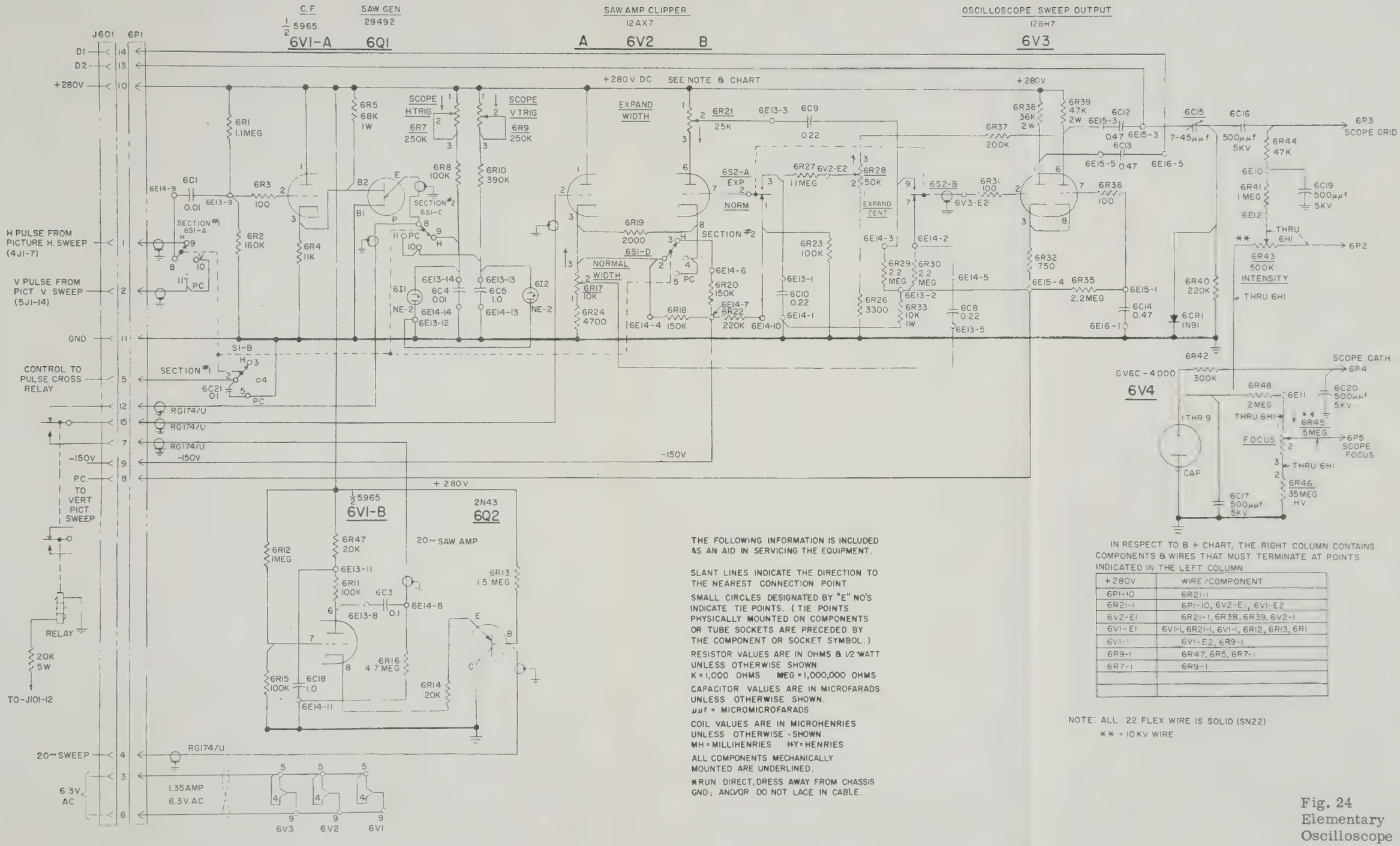


IN RESPECT TO B + CHART, THE RIGHT COLUMN CONTAINS COMPONENTS & WIRES THAT MUST TERMINATE AT POINTS INDICATED IN THE LEFT COLUMN.

+280V	WIRE/COMPONENT
6P1-10	6R21-1
6R21-1	6P1-10, 6V2-E1, 6V1-E2
6V2-E1	6R21-1, 6R38, 6R39, 6V2-1
6V1-E1	6V1-1, 6R21-1, 6V1-1, 6R12, 6R13, 6R1
6V1-1	6V1-E2, 6R9-1
6R9-1	6R47, 6R5, 6R7-1
6R7-1	6R9-1

NOTE: ALL 22 FLEX WIRE IS SOLID (SN22)
** = 10KV WIRE

Fig. 24
Elementary
Oscilloscope
Sweep



THE FOLLOWING INFORMATION IS INCLUDED AS AN AID IN SERVICING THE EQUIPMENT.

SLANT LINES INDICATE THE DIRECTION TO THE NEAREST CONNECTION POINT.

SMALL CIRCLES DESIGNATED BY "E" NO'S INDICATE TIE POINTS. (TIE POINTS PHYSICALLY MOUNTED ON COMPONENTS OR TUBE SOCKETS ARE PRECEDED BY THE COMPONENT OR SOCKET SYMBOL.)

RESISTOR VALUES ARE IN OHMS & 1/2 WATT UNLESS OTHERWISE SHOWN
K = 1,000 OHMS MEG = 1,000,000 OHMS

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ALL COMPONENTS MECHANICALLY MOUNTED ARE UNDERLINED.

*RUN DIRECT, DRESS AWAY FROM CHASSIS GND; AND/OR DO NOT LACE IN CABLE.

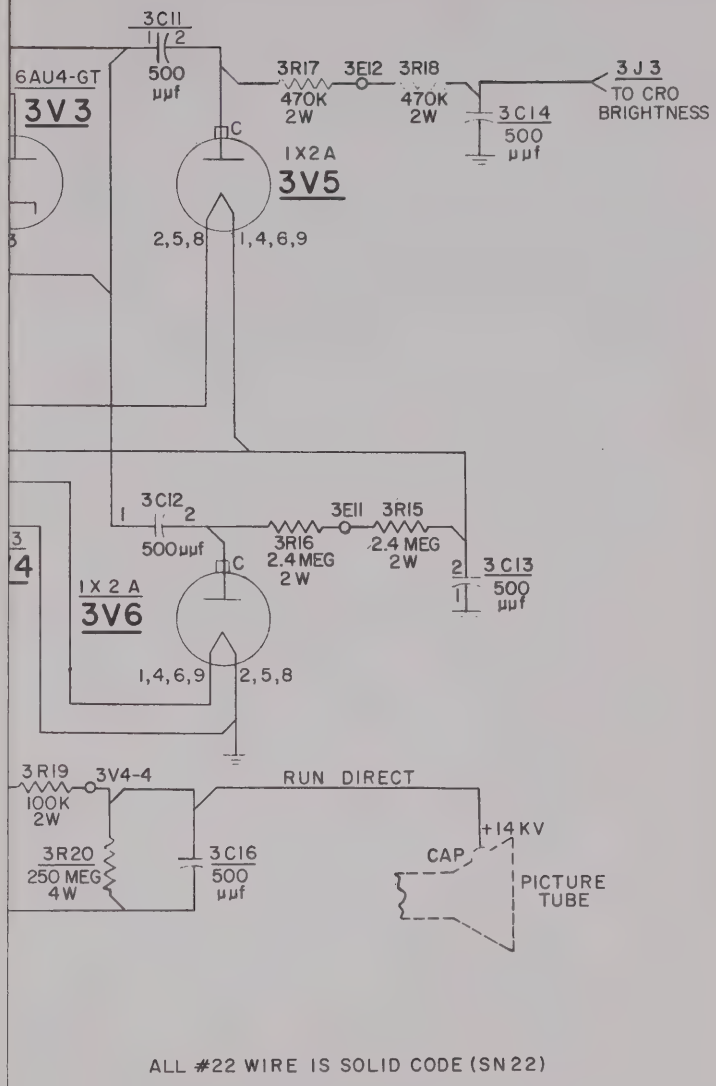
IN RESPECT TO B + CHART, THE RIGHT COLUMN CONTAINS COMPONENTS & WIRES THAT MUST TERMINATE AT POINTS INDICATED IN THE LEFT COLUMN

+280V	WIRE / COMPONENT
6P1-10	6R21-1
6R21-1	6P1-10, 6V2-E1, 6V1-E2
6V2-E1	6R21-1, 6R38, 6R39, 6V2-1
6V1-E1	6V1-1, 6R21-1, 6V1-1, 6R12, 6R13, 6R1
6V1-1	6V1-E2, 6R9-1
6R9-1	6R47, 6R5, 6R7-1
6R7-1	6R9-1

NOTE: ALL 22 FLEX WIRE IS SOLID (SN22)
** = 10 KV WIRE

Fig. 24 Elementary Diagram, Oscilloscope Sweep Subchassis (D-7670845, Rev. D)

Fig. 24 Elementary Oscilloscope Sweep



ssis (C-7777998, Rev. B)

Fig. 25
Elementary
High-Voltage
Power Supply

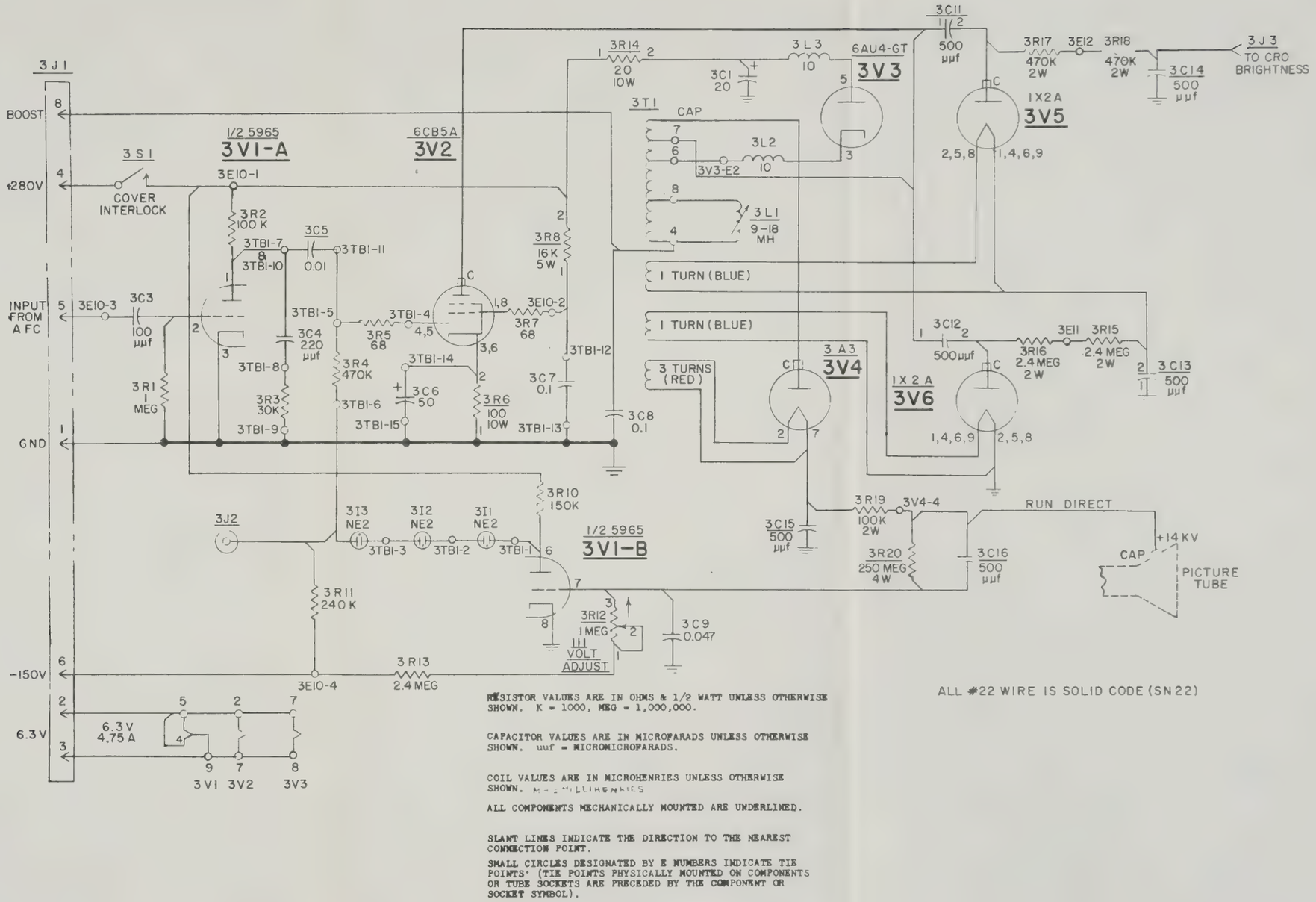


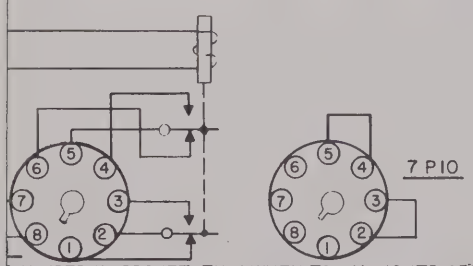
Fig. 25 Elementary Diagram, High-Voltage Power Supply Subchassis (C-7777998, Rev. B)

RESISTOR VALUES ARE IN OHMS & 1/2 WATT UNLESS OTHERWISE SHOWN.
K = 1000 MEG = 1,000,000

CAPACITOR VALUES ARE IN MICROFARADS UNLESS OTHERWISE SHOWN.
uuf = MICROMICROFARADS.

ALL COMPONENTS MECHANICALLY MOUNTED ARE UNDERLINED.

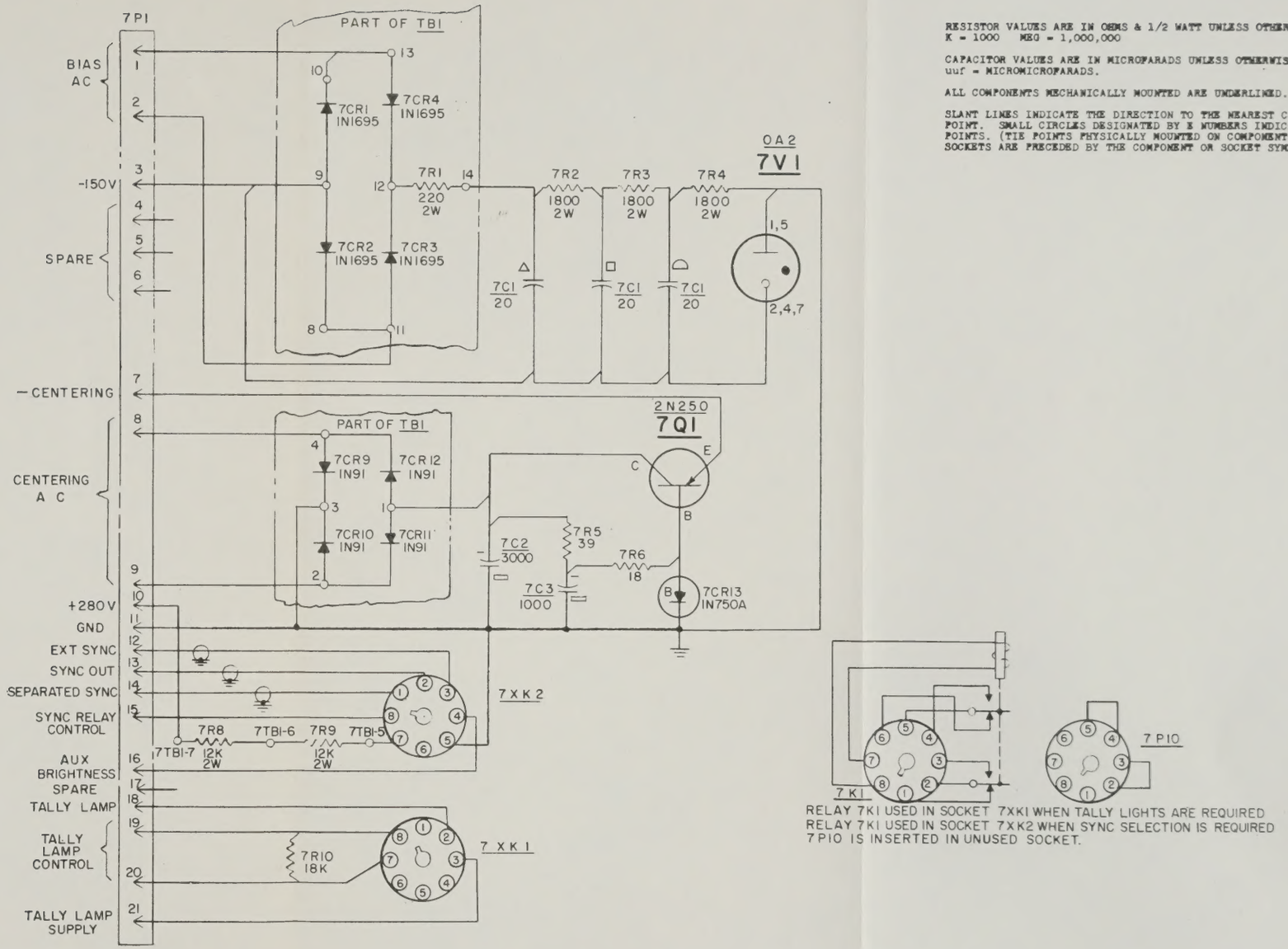
SLANT LINES INDICATE THE DIRECTION TO THE NEAREST CONNECTION POINT. SMALL CIRCLES DESIGNATED BY E NUMBERS INDICATE TIE POINTS. (TIE POINTS PHYSICALLY MOUNTED ON COMPONENTS OR TUBE SOCKETS ARE PRECEDED BY THE COMPONENT OR SOCKET SYMBOL)



7KI USED IN SOCKET 7XKI WHEN TALLY LIGHTS ARE REQUIRED
7KI USED IN SOCKET 7XK2 WHEN SYNC SELECTION IS REQUIRED
INSERTED IN UNUSED SOCKET.

(C-7778063, Rev. A)

Fig. 26
Elementary
Bias-Centering-
Relay



RESISTOR VALUES ARE IN OHMS & 1/2 WATT UNLESS OTHERWISE SHOWN.
K = 1000 MEG = 1,000,000

CAPACITOR VALUES ARE IN MICROFARADS UNLESS OTHERWISE SHOWN.
uuf = MICROMICROFARADS.

ALL COMPONENTS MECHANICALLY MOUNTED ARE UNDERLINED.

SLANT LINES INDICATE THE DIRECTION TO THE NEAREST CONNECTION POINT. SMALL CIRCLES DESIGNATED BY # NUMBERS INDICATE TIE POINTS. (TIE POINTS PHYSICALLY MOUNTED ON COMPONENTS OR TUBE SOCKETS ARE PRECEDED BY THE COMPONENT OR SOCKET SYMBOL)

Fig. 26 Elementary Diagram, Bias-Centering-Relay Subchassis (C-7778063, Rev. A)

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